Prairie Pod Transcript

Season 3, Episode 1: Mussel Mania

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Guests: Mike Davis, DNR Malacologist, Bernard Sietman, DNR Malacologist, Madeline Pletta, DNR Propagation Biologist

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

Transcript:

((sounds of birds chirping and wind blowing))

Megan: Hey, welcome back. It's Season 3 of the Prairie Pod and I am so excited because we're sitting here in the mussel lab in Lake City, Minnesota and not only are we sitting here with some fabulous mussel peeps, but we also have our brand new co-host.

Mike: That's right.

Megan: That's right. ((Laughter)) I'm trying to introduce you here it's gonna be epic.

Mike: Oh sorry. Ok. Please carry on.

Megan: Our brand new co-host, Mike Worland. ((Making cheering noises))

Mike: That is, that's way over done. Okay.

Megan: Okay, so much.

Mike: That was Mike Worland and I'm a non-game biologist. I work in southern Minnesota with the DNR and I'm, I am excited. This, you picked a great first episode. The topic is awesome.

Megan: I know, it's mussels and I'm not talking about the muscles on your little beefy arms there. I'm talking about - -

Mike: Thank, thank gosh.

Megan: Woo, I know, we don't want to talk about those. We're talking about mussels! Some people call them clams. We're going to learn all about them today because like we said we're sitting in the mussel lab and we're going to let our fabulous guests introduce themselves. Mike, other Mike.

Mike D: Oh me first, okay. Mike Davis. I guess I've been here for a long time. ((Laughs)) what else do you want me to tell 'em?

Megan: ((Laughter)) We'll get into all the things that you know in a minute.

Mike D: Okay.

Megan: Maddie, do you want to introduce yourself?

Maddie: I'm Maddie Pletta. I'm the propagation biologist, one of two of us that are here in Lake City.

Bernard: I'm Bernard Sietman. I'm a malacologist with the Minnesota DNR.

Megan: For those of you who haven't figured it out being a malacologist is a fancy name for being somebody who studies mussels.

Mike: Does not mean a bad ecologist.

Bernard: Or mollusk.

Mike D: Malacologist

Megan: Mal-ecologist, I never thought about it. I'm a mal-ecologist; I have malpractice with my mussels.

Mike D. Right?

Megan: No. I never thought about it that way.

Mike D.: Gotta make sure nobody gets confused.

Megan: Yeah, that's good.

Bernard: We don't want to leave the snail people out.

Megan: Oh that's true we don't want to leave them out. So today's podcast title is called Mussel Mania and we are super excited to go through all the things. Now, because - -

Mike: Hulk, Hulk Hogan reference right? Megan, do you even know who Hulk Hogan is?

Megan: Copyright. ((Laughter))

Mike D.: Professional wrestler.

Megan: ((Laughter)) Yeah, thank you. I do know who Hulk Hogan is. Wow, how young do you think I am?

Mike: Now we just talked about this. Yeah, you know he was, he was a childhood hero, so.

Megan: That's good, he used to come in my--

Mike D.: It was Wrestle Mania not - -

Megan: Didn't he come in cereal boxes like a little action figure like little Hulk Hogan action figure?

Mike: I don’t know.

Mike D.: I was going to say he wouldn’t fit in a cereal box.

Megan: Well not the actual man.

((Laughter))

Megan: Oh gosh, cause if it’s mussels, okay, bring it right back to mussels, here we go. ((Laughter))

Mike D.: Mussel mania, there you go.

Megan: As we start every season, we’re going to start this season with a quote from the father of conservation, the man, the hero, you know him as Aldo Leopold and so I’m going to read this quote and then we’re going to reflect on it just before we jump into our topic. So “conservation is a state of harmony between men and land.” What do you think of that?

Mike W: It’s beautiful and you’ll never hear me say anything, I mean I love Aldo Leopold. He’s, he’s a bigger hero than Hulk Hogan, okay?

Megan: Wow.

Mike W: By far.

Megan: That’s big, really big.

Mike W: Mm-hmm.

Megan: Proud of you. The reason we picked this quote to start off the season is because we're thinking about our approach to conservation and since we're jumping into season three, we've got two episodes under our belt, we really wanted to focus on this theme. So we hope that you're going to see that this quote is really a reflection of the theme through all season three. We're trying to demonstrate ways that we can work better with each other so that we can do better not only for the environment, but when you do better for the environment, we're doing better for ourselves. ((singing)) Holla environment! Okay, so, we're going to jump right in, we're going to round robin here. You guys tell us a little bit about the work that you do here, and we're going to have to talk a little bit loud because we do have some, some air noise. So, Mike, tell us a little bit about your work.

Mike D: Well, we do a lot of things here actually, the mussel program has a long history that you probably don’t know about, but it started out with doing surveys at rivers to see what kind of native mussels were living in them. Since that time, we've grown the program, surveyed over 4,000 sites around Minnesota, established 16 long-term monitoring sites where we collect very intense datasets of the mussel community living at these sites, and once we had gained the knowledge, I guess you could say from running all around, we identified some places where we thought the mussel community could be re-established. And we knew that there were species missing, because when we were doing the surveys, we'd find empty shelves of species normally living in the river. So that gives us a reference condition attempting to reconstruct what used to be

and so that’s what we've moved into now here at the lab, is trying to work with several different species on right now three different river systems in Minnesota to propagate artificially like a hatchery kinda thing, propagate and raise and then release mussels back into these rivers. So it's pretty exciting.

Megan: It is exciting. And because you mentioned propagation, Maddie, do you want to talk a little bit about your work? He's like queueing you right up.

Maddie: He is queuing me, but he also covered everything. ((Laughter))

Megan: He also stole all the things you were going to say?

Maddie: Stole my thunder, yeah. So, propagation, so we're, we're artificially in the lab, we're creating this mussel host relationship. We have host fish that we come keep on hand in the lab, anywhere between 200 and 300 walleye we have on, in the lab, a couple hundred large mouth bass and so many species that relate to Bernard’s work. And anyways, what we're doing is we're collecting gravid females or pregnant mommas and we create this little larval bath with our host fish and essentially then we have a series of systems that we have that actually are specifically designed to collect juvenile mussels. So, a juvenile mussel, when it drops off the fish, we'll probably talk about the life cycle soon, but when they drop off the fish, they're like a pinhead in size. So if you can image, that’s really, really small. And so what we're doing is we're taking that pinhead size baby mussel and we're growing them all the way up to be a few inches in size. And so we have different systems set up that help us to maintain their health and kind of mimic the environments they would be at in a river, and eventually we do put them in the river and yeah, it's all about restoration, so we're getting there.

Megan: That’s really cool. And you said something that I want to make sure that people understand who maybe are listening to the podcast and they're not as familiar with what it means to be host, a host species. So correct me if I say anything wrong here. So most mussels need a host fish meaning that their eggs attach to the fish and then they emerge, am I getting this right? Sort of close?

Mike D: They're not the eggs, but larvae - -

Megan: Well the larvae, yeah. Sorry, sorry, yeah, let’s be clear, let’s be accurate.

Mike D: There's a whole interesting part of eggs becoming larvae too, Bernard might be able to tell you about it.

Bernard: It happens, over a few days.

Mike: Bernard.

Bernard: Yeah.

Mike W: A malacologist is a profession that it's kind of a mystery to probably just about everybody, can you tell us more about what that means or what it takes to become a malacologist?

Bernard: Well, I mean in a broad sense, malacology is, you know, anyone who studies mollusks. So, us, we study fresh water mussels, but there's other folks that, who study snails or octopi or what else, what else are there other than that?

Mike D.: Squids.

Bernard: Yeah, squids and things like that.

Mike D.: Snails.

Bernard: Snails, so that's, you know, that's the other group. So that's a malacologist, it's, you know, studying the phylum mollusca.

Megan: Oh, that's a fun word to say, phylum mollusca. ((Laughter))

Bernard: Yes, the second, second most - -

Mike D.: Be a nice name for your kid wouldn't it?

Megan: Oh yeah, phylum mollusca, that'd be easy to spell for sure in first grade. Not a problem if they identify for short. ((Laughter)) Oh lord, help us. So, Mike, does ((Laughter)) I know, there's going to be a lot of laughing today because this is just such a great crowd, you can already tell they're super excited about the work they do and we're excited to learn about it. So we want you to give us a little bit of an understanding of mussel biology, and then before you tell us the background of that, let's start us off with what's sort of the trend that we're seeing with mussels. And you already kind of hit on it with your intro where you're talking about how there's shells that you've seen and you know that those species aren't there anymore, but they used to be there and it gives you kind of this reference point. But what's going on with mussels in general in Minnesota?

Mike D.: You want the good, the bad, and the ugly.

Megan: I do. ((Laughter))

Mike D.: Well, the good thing is that we still have mussels in many of our streams and lakes, and well the bad news is there's a long history of humans having had a very negative impact on populations and probably dates back to the early days of settlement when somebody discovered that some of these produce pearls. And if someone found a pearl in the river that was worth a couple hundred dollars then there would be a pearl rush and all the poor little mussels in the river would get dragged out and cut open and most of them didn't have anything in them so there was a lot of destruction. And then a, a guy from Germany discovered that he could make buttons out of the shells that he was finding from the pearl hunters probably and that started a new industry of button-making. And there were button factories all over the, all over the US really, the eastern half of the US and Mississippi no exception. That actually started in Muscatine, Iowa and quickly spread all around North America. And so millions upon millions of mussels were dredged or booked or pulled out of rivers and turned into buttons and everything that knocked the populations way downwards. Judging from the harvest records, they were exceedingly abundant in rivers, they formed the bottom of the rivers in places.

Shells of the ancestors of the mussels living in the river today. And some of them lived to be very old, some species lived to be over 100 years old.

Megan: Holy cow.

Mike D: Yeah, so in Minnesota, we've identified about 51 now I think species.

Bernard: 51, I believe.

Mike D: Yeah, with *Lampsilis sietmani*, which we'll get to later.

Mike W: You think there's a legacy from that destruction?

Mike D: Yeah, a legacy is what happened, you know?

Mike W: - - or the effects are still going on now you think?

Mike D: Yeah, it probably is because you don't have that large populations that are much more resilient to other things that came along later, which happened, you know, we threw everything in rivers as our population centers grew and think Minnesota probably could have distinction of the first bed zone in the Mississippi rather than the Gulf of Mexico because of the Twin Cities. All the sewage and the stockyard waste and all the industrial waste went into the river, beginning probably around 1900 or a little before that, then so we had this legacy of polluting, in the meantime building dams which block fish movement, which is how mussels get distributed in the streams, with fish moving, carrying their larvae. But the good news part, now, back to the good news, is that the Clean Water Act was passed in 1972 and that forced all sorts of changes to improve water in it. You know, took about two decades for that to start to be very noticeable but beginning of the late 80s to the early 90s, we saw a dramatic improvement in some of our river water quality. So essential things like oxygen returned to the river in downtown Minneapolis/St. Paul. The ammonia levels from sewage sludge buildup plummeted and viola, the river supports life again, no longer a dead zone. And a lot of that, I attribute to the citizens who rally around all that and it was two women that lived around Lake Pepin, one in Wisconsin, one in Minnesota, they started one of Minnesota's early environmental groups called Citizens for a Clean Mississippi. And their motto was we can't all live upstream, and you know, Lake Pepin, when I was a kid, you couldn't swim in it. There was signs posted on the beach because of the bacteria levels were unsafe. And you don't see that anymore, everybody takes it for granted today but there was a time when we were in really rough shape. And those two women rallied several thousand people to join them and petitioned legislators in Wisconsin to sue to the state of Minnesota over polluting their side of Lake Pepin. And the agreement that came out of that was to separate the sanitarian storm water systems in Minneapolis, St. Paul and upgrade sewage treatment facilities to return what had already been established as minimum clean water standards. That, that's been done. I mean not that we don't have pollution issues, but at least life has returned. So those things have given us opportunities to try and reintroduce mussels at the sites we're working on now. There's probably some others we haven't, you can only do so much at a time, you know? So that's kind of the history of where we got to, I forget what you asked me now.

((Laughter))

Mike W: That was great, it was good.

Megan: It was great. Tell us a little bit, so people obviously have an influence on their environment but you started mentioning too the impact that mussels have on their environment. What, why are they so important? So you talked about this where they're basically the foundation of the river where they're covering the bottom. That's certainly not the case now so what are they doing for that river system?

Mike D: Well, they get their food or oxygen by bringing water from the river or the lake in through their shell, taking out the food and taking out the things that aren't edible and digesting what is and in the process of doing that, they actually clear stuff out of the water so that's the suspended organic matter primarily that they're removing from streams and rivers. And part of what they seem to really have a case for are E. coli bacteria. So that's what, you know, this is recent research, I didn't, we didn't know that when we started doing surveys. We just thought mussels are cool and wanted to know more about them. Got into the conservation but now this other idea is opening up where mussels actually clean our rivers up. If we can clean the rivers up enough to support them again, they'd take it to the next level probably.

Megan: So they're like nature's Brita filter.

Mike D: Yeah, somebody, you pick that up somewhere. That was on some other radio thing.

Megan: It's not my first rodeo. ((Laughter))

Mike D: But anyway, some things that we're hoping to in the next few years start working more and more on that aspect of it and see if we can measure some of those and develop some goals for mussel restoration. There really are based on trying to clean up some of the streams around the state.

Mike W: Tell us more about how these animals reproduce. It sounds like a really interesting process that we don't know much about. Which actually I don't know anything about, it's kind of weird.

Bernard: Yeah, it's crazy, it's one of the things that makes them unique. So, you know, mussels reproduce like, you know, other, some other aquatic organisms. They spawn, and the male mussel will release the sperm into the water and the female will take that in and eggs are fertilized, but at that point, they develop into larvae inside the female's gills, where she broods them for a period of time. It's a type of parental care and it can last for months or just, you know, weeks. So she's holding these larvae in her gills and to get them to the next stage, all fresh water mussels and Unionida that order of mussels, they're temporary parasites on primarily fish. So these larvae have to attach to the appropriate species or group of fish and go through a metamorphosis. So these larvae will attach, they'll be encapsulated in the tissue of the fish, usually this is on the gill - -

Mike W: Think somewhere I read they're like little pac-men. Is that right?

Bernard: Little Pac-men they look like, yeah, so, yeah, a little - -

Mike W: Okay, pac-man on the gill?

Bernard: That's a good point. So the larvae that we work with, they look just like a little miniature clam, I mean, it does. And it does look like a Pac-man because they open up and just kind of sit there, you know, when you have them in a petri dish, at least. But they do look like a little Pac-man. And they have one, they're very, you know, primitive. They don't have all the parts that a, a juvenile mussel would have. I mean they only have like a little abductor muscle that closes the shell. That's all they can do, is open it up and close. And when they attach to the, the fish, you know, it's usually the gills. They sort of like --

Mike W: So, just say it again, is it species-specific to fish, it can be at least?

Bernard: It can be very specific.

Mike W: Like a certain species of mussel, like a certain species of fish right?

Bernard: Well yeah, I mean it could be both. I mean they're, you know, mussels can be classified as very host-specialist, so they're host specialists. Then a good example, we have four genera in Minnesota that can only transform to the juvenile stage on fresh water draw. So I mean it's, it's several species in the country that are specialists on freshwater draw and that's one, to the extreme example of that. And there's other ones that, other species that can transform on a range of fish species so they're called generalists. Then you got things everywhere in between, you know, we have unique species that specialize on catfish. We have species of mussels that specialize on sturgeon and darters, and sunfish. On mooneyes. And goldeyes. So it 's a - - there's very few species of fish in the wild that don't serve as hosts.

Mike W: Now, does it do any harm to the fish when they're being parasitized?

Megan: Oh that's what I was going to ask.

Mike W: I'm sorry to steal your thunder, Megan.

Bernard: I'll use, you said harm, and I'll say that under normal conditions, no, it's not harmful.

Mike W: Okay.

Bernard: Under abnormal conditions, you know, with the very intensive batch of larvae, we're talking hundreds or thousands, then it can be maybe a little more dicey. So yeah, so once you get to that point, these larvae get onto the right species of fish, they over a period of time go through a metamorphosis. They grow all their parts that are necessarily for life, the gills, the gut, their foot that they use to crawl around, all that stuff grows when they're around the fish. And over, generally a couple weeks, that's sort of like the standard you know, if you're going to throw a number out but it can range over a longer period of time depending on some various things. And at that point, they will, when they're fully develop, we use the term release from the fish but they basically somehow rupture their little encapsulation and will just fall to the river bottom. And begin

life as a free-living juvenile and if everything goes well, they'll grow up to be a big momma or daddy mussel.

((Laughter))

Mike W.: One of the coolest sayings that we, I don't think you - - maybe you mentioned it but we talk more about it though, I saw it on You Tube yesterday. It was so cool. These things put out a little lure, some species of mussels put out a little lure to draw their host fish in.

Bernard: Yeah.

Mike W.: And for me it was amazing because that little lure that they put out looks exactly like the prey fish that the host fish is going after. I thought it was amazing.

Bernard: It's a thing that really gets people, us included. We are still amazed by these things. Like the classic example is the plain pocketbook is a common mussel in Minnesota. They have a modified portion of the mantle which is the part that basically makes the shell. But they've got an extension that when the female is birding the larva she will inflate this little extension that looks just as you described and like a minnow and she will flap this little minnow underwater and not only that, you know, the mussel is primarily - - mostly buried. So it's buried, but they've strued this tissue out and even beyond that, they'll push that brood, so the gills. I mean you can imagine that the mussel's gills are what it uses to breathe and everything else they push that in between these two flaps. You got a left and a right, so you got too little mouths there that are flapping around this brood and the gills, and, so, you know, the way that they infect the fish is a bass or a walleye see this little minnow and it's like I'm going to go after that and they will attack that fake fish and rupture those gills and suck in the larva and there you have it.

Mike W.: I thought it was an amazing example of evolution because the mussels are blind.

Bernard: Oh, yeah.

Mike: So this thing's been developed purely through the evolution.

Megan: It all sounds very creepy to me to be honest. It's like, it's magical and mussels are wonderful, don't get me wrong, but like it's like an alien movie. They're like come in little fish and here's all my larvae inside of me now, ha, ha, ha. It' a very kind of - -

Mike W.: Cool.

Megan: It's cool in a very creepy kind of way. I mean I like it. They've done some amazing - -

Bernard: We do have a mimic of the alien you speak of. (Laughing) The little snuff box - - you know there's a group of mussels that they decided that it was - - they didn't decide obviously, but they actually capture the fish. You know, they're not going to entice the fish, you know, come - - well, they do entice them to come bite them. But they set the little trap. They park their valves open and sometimes they draw them in with colors or like a little bit of wiggly, you know, miniature little extensions. But the one that we have,

which is a snuffbox, a fairly endangered mussel, it pretends to be a little pebble and it will sit in the sediment. The female will sit in the sediment and the primary host for that mussel is a log perch. Log perch had a habit of flipping rocks to find food. So here's this little rock, aka female snuffbox mussel and it will stick its nose to flip this rock and mussel will clamp down on the fish's head and catches it temporarily. It inflates a little gasket around. Now you can go back and let's all watch Aliens one more time, and it will extrude the larva into the fish's mouth and then when it's finished it will let the fish go.

Mike W.: Wow.

Megan: Nature's so weird and wonderful. It's very true. Bernard, before we move onto Maddie here I want you to really click. So those of you who don't know the mussel lab has grown over the years and, in fact, the first time we came to visit it we went to a different manufacturing warehouse because it's basically a set of sheds out in Lake City and so you don't really know where you're going. And you walk into this distributing warehouse and you're like I'm looking for the mussel people. And the lady looks at you and she's like yeah, I don't think that's us. So we knew we were in the wrong spot. But we found it. It's a nice little - - how would you describe It?

Mike D.: Incognito.

Megan: Yeah. It's a little incognito lab here in Lake City. But doing lots of amazing things so Bernard I want you to tell us pretty quickly about one of the many amazing conservation discoveries that you told us about last time that came out of Lake City right here in this little lab.

Bernard: Well, I think you're talking about the spectaclecase - - the host for the spectaclecase. So that was a species that folks have been trying to determine what the host is for quite some time. Not just here in Minnesota, but other labs in the country, in the university folks can say these things too. And it seemed to be this thing, this unattainable just discovery to figure out what the host is for that. I should mention that that spectaclecase is a different family- - it's the only mussel we have in Minnesota that's from a different family of mussels than most North American mussels. So, it's in the Margaritiferidae so it's different in that way. But it's different in some other ways too, but, you know, we were, you know, intent on figuring out what this was and, you know it took several years - - I should mention that we collaborate with Mark Hove at the U of M. But the discovery happened here. And we narrowed down on what, you know, the possibilities were. I mean we had tested lots and lots and lots of species. We usually use the, we call it the shotgun approach where you just test as many different species of fish as you can and nothing was happening. They always rejected the larva. So actually it had to do with part of our survey where we were on the St. Croix River, which is where the only population that we know of spectaclecase in the state is in the St. Croix and we had surveyed above and below the St. Croix Falls dam. And historically that species occurred throughout that reach of the St. Croix. But now with the dam the populations above are dwindling and dying out. But downstream the populations are reproducing and we can find baby spectaclecase so there's always something happening here. And, you know, I thought, maybe I should get a list of fish from above the dam and below the dam to see if there's anything that stands out. And I did that and I contacted Conrad Schmidt who's a well-known fish guy in the state and he just literally handed me a list of

historical fish, you know, above and below and current species above and below and boom it was like a beacon and the mooneyes and goldeyes just kind of popped out right away. One because we've never checked them in the lab. I don't think anybody - - I don't know anybody that's worked on them elsewhere. They're really hard to deal with, hard—not easy to catch. They die. Hard to keep alive in the lab. So we, you know, focused on that fish species or both those fish species and, you know, boom, we figured it out. You know, I think Maddie and I were in the lab that day when we - - so, you know, it takes a while, this is a species that they don't actually - - it takes over three weeks for them to transform but we knew that they still were attached and growing. So this mussel actually grows when it's on the fish. I knew that it was going to happen and it just turned out on a weekend day I think. Looked through some samples and maybe this is the day and boom there they were. There was a crawling little baby spectaclecase. It looked like an alien. I've never seen anything like it.

Mike W: They're very different from other mussels.

Maddie: They look like donut holes.

((Laughing))

Maddie: The perfectly round spiracle little juveniles and then all of a sudden stick out this foot and it looks like a tongue and you are looking at a donut hole. Not that I was hungry, but they became known to me as the donut hole.

Megan: The donut holes.

Bernard: We did a big high five. It was a great day to be a biologist.

Mike W. Well done. Proud to be a Minnesotan

Megan: Well, done. Let's just be clear. That was a 30-year-old puzzle that you solved here. You should be very proud of that work.

Mike D.: Thanks to the hundred year lifespan of the spectacle case it helped us figure it out because those ones that were above the dam, the dam was 100 years old.

Megan: Oh, my gosh.

Mike D.. So they're dying and there might not be any left at all. The biggest challenge really was keeping the dang fish alive.

Bernard: It was a challenge.

Mike W: And two years to keep it alive long enough to actually confirm the juveniles, you know. Bernard was really excited after the first year.

Bernard: I was.

Mike D.: We almost got there and then all the fish died.

Bernard: I knew. I mean at that point in time when we didn't know those fish died, I mean the development that had occurred like this is it.

Mike D.: It's got to be it.

Bernard: And yeah, we just got some better systems to hold the fish in. And we also went out - - so as I mentioned, there are two species. There's the mooneye and the goldeye. So we had worked on mooneye out of the Mississippi River. And they're particularly difficult to deal with and so I thought well, maybe we should go get some goldeye too. I mean they're the same genous. It's certainly - -

Mike D.: It's a unique family.

Bernard: It is, it is, yeah. There's only those two species of fish in that family. And we went out and got goldeye in the Red River in the north and they turn out to be almost as easy to keep as goldfish. They survive really well. I mean as fish in captivity though they do pretty good. The mooneye, on the other hand, they're still a challenge. We haven't cracked them.

Mike D.: We looked at them. They were roll over dead, you know.

Megan: But you guys solved it, which is a huge deal.

Bernard: And we did keep some mooneye alive long enough to get - - I mean, we babied them long enough to get them to work so.

Mike D.: And then you got some out of the wild and had larvae on the gills and transformed them in the lab so that really was the final whammy. This is the host in nature.

Megan: That's amazing.

Bernard: Yeah and that's the big home-run is when you can identify that - -

Mike D.: Functional host.

Bernard: Yeah.

Mike W.: That brings up the importance of propagation and restoration with these rare mussels. Can you tell us more about that work Maddie and why that's so important?

Maddie: Yeah. So kind of, if you think about how our program has been structured, we get all of these survey and monitorings and then Bernard with the host research has been able to produce or with all the host research that has been produced at our facility we're kind of that last piece of the puzzle as this actually artificially raising these guys in culture. And so we actually from the original batch of spectacle case mussels that dropped off fish we have several hundred that are still alive in Hudson. They’re kind of our last step in juvenile culture in the lab is to put them inside a tote. When I say tote I literally mean you put your Christmas trees in here at the end of the season. Series of holes drilled in the side and we stick them at the bottom of the lake. We have three sources, three of our watersheds that we work with all have their own natural settings as far as where we go and put totes. And there are I know at least 250 to 300 that are alive from the original spectacle case mussel. And when we looked at them, we pulled the tote this year just to double check to see how they were doing and they had almost doubled in size. They're, I think, about probably two and a half inches long would be my guess. I couldn't tell you straight off. Propagation is this almost like green thumb type thing. I don't know. If you own a greenhouse and you can get plants to grow, well,

maybe you should be a mussel biologist. Juvenile muscles they, you know, you almost understand why they're in periled. They're not exactly the easiest things to keep alive. Water temperature, water chemistry, too much food, too little food, not enough substrate, too much substrate, all affect newly metamorphosed juveniles. So, when I say newly metamorphosed that's right off the fish when they're that pinhead size. So these little baby juveniles are pretty picky. They're premadonnas and what we're doing here is we're working with different systems that we have. We have two main ones in place. One of them is as simple as a little bit of mud and some river water that we feed once, twice a day. And then we have this secondary or another system that actually like almost mimics a river in that every 30 minutes this pulse of water comes. So just imagine you have a cup of water and every 30 minutes you're going to add 50% new water. So you're going to get this interchange and so that's our second system. We have little baby juveniles in the bottom of the cup and we're just supplying a refresh of food and water and we have really good success. This is the first year of doing that and for the last three years we've been kind of experimenting with different substrates whether it be sand or mud and where to get the mud. You know, every small aspect can influence mussels either positively or negatively, so.

Mike D.: Yeah. One big thing with this little guys is they're very sensitive to chloride. Now we have a chloride issue so that's something that's on our fear screen, I guess you can say. Quit throwing all that salt in the river.

Megan: Yeah, I guess, and we should mention before you start getting real excited and thinking about putting a bunch of totes in your house and trying to do this on your own, in, you know, you get really excited about conservation mussels and you're like I can help. I've got 17 totes at my house. They're about, I don't know, quite a few permits that go into this. There's quite a few things that we have to do. I use the word few loosely here. There are many things that the lab has to do to make sure they're operating safe standards to make sure that they harming, you know, not harming wildlife and trying to do the best job possible keeping these critters alive and making sure that they get outsourced sustainably and safely. So there's lots of things that you guys have to do and maintain to make sure that this is going on and that you can keep doing it all for the good of the species, right? Because the idea is that you need mussels and so if we don't have mussels we're going to have to find a way to get them and so this is one way to do it. I was impressed when we toured the lab last time, how many baby mussels there are and how many you're managing. Can you talk about that just a little bit Maddie? About how many different species you're managing and then how many babies they actually make. Because it's kind of like the sea turtles phenomenon, right? If you're a mussel, you can make a lot of babies in the hopes that you have a couple or a few survive basically.

Maddie: No, that's exactly right. So we have, shoot, 14 - -

Mike D.: Lost track of how many.

Maddie: There’s so many. I'd have to count them out on my hands. So we work in three different watersheds and between those watersheds the St. Croix and Mississippi is the one that has the most amount of species. I think there are seven or eight species that we're working with just within the St. Croix/Mississippi and overall 10 mussel species

are held in our lab. And so what it is, is it's a little bit of I almost call it a dance. We have everything color coordinated and different mussels though they may be the same species, they may be propagated from our three different watersheds. The Cannon River, the Cedar River and the St. Croix/Mississippi are kind of lumped together. And so you know we kind of have to balance this, where the mussels are coming from as far as the watershed and then where they're growing as juveniles. So when we do a batch of mussels, say we're inoculating 20 walleyes with some mucket glochidia we kind of hope that that batch should produce maybe 50,000 to 100,000 mussels. I know that number sounds huge; however, in the end we're really hoping that, you know, when we'd like to say 50% I think reality is probably in that 10% range are going to survive to actually be released.

Mike W.: And that word glochidia, is that what you said?

Maddie: Glochidia is their larval form.

Mike W.: That's the larval form.

Maddie: That's the Pac Man.

Mike: That's the Pac Man.

Megan: You can impress all your friends now at dinner parties and be like did you know I saw some glochidia today?

Mike D.: Oh, yeah. There's another big word that I didn't use Spermatozeugmata, right?

Bernard: Spermatozeugmata.

Mike D.: That's how the male packages the sperm.

Bernard: Yeah, right into a little ball.

Mike D.: And delivers this ball with a thousand sperm cells that explodes when it gets inside the female and takes care of all those eggs, you know.

Mike W.: I'm just going to point out the names of these things. I love the names of these mussels. They have the coolest names of any group of animals. The spectaclecase.

Megan: Snuffbox.

Mike W.: Creek Heelsplitter. A fatmucket. The lilliput. There are some others. The pimpleback. Monkeyface.

Mike D.: That's a difficult one we've found to work with. We're working on it though.

Mike: Monkeyface has got to be difficult, yeah.

Mike D.: Yeah, right. They're beautiful mussels though. Actually the Cedar River Monkeyface are just really, really beautiful.

Bernard: Yeah.

Mike D.: But we have to go to Iowa to find them today and that's why we're trying to get them back in Minnesota. They used to be in the - -

Bernard: In the Cedar.

Mike D: In the Cedar.

Mike W: One thing we should emphasize is the connection between prairie and these mussels. This is a show about prairie, a terrestrial ecosystem and we're talking about mussels, which is an aquatic critter. Can you help us understand the importance of prairie for mussels?

Mike D: Yeah, sure. I mean prairies have rivers as well and streams and actually the Minnesota River is a giant prairie river. And at one point it supported most of the mussel biodiversity in the state of Minnesota. That supports migrations of fish from the Mississippi way on out all the way to the Lac qui Parle and beyond. In fact, there are several species of mussels that have been extirpated; in other words, they don't live in Minnesota anymore. And a couple of those were unique to the Minnesota River, one being the Gulf Maple Leaf and we find old shells of that in the Minnesota River and also there are museum records of another species called the scaleshell. It has a real thin shell so records don't persist very long, but someone sent one to a museum once back in the 1800s. The sad part is we look today, you know, to the St. Croix for our biodiversity studies of mussels and what they do because they still have 40 some species. The Minnesota River once had 42 and we've lost half of them in some of the tributaries and the very lower part and more than half of the species. So prairies are really essential to the health of prairie rivers so the grass is good, you know. I think that the grasslands especially alongside streams are probably good for fish and for mussels.

Mike W: Yeah. I think I read that mussels, some people are saying they're the most imperiled group of wildlife.

Mike D: Yeah. And then you know, the third and four categories of wildlife that were in that study are all aquatic dependent species. It includes mussels, snails and you know things like crayfish and amphibians that all have a connection to water. And then over the times we've seen a lot of emphasis on things like birds and butterflies, but we see them. They flutter around or come to the birdfeeders. We don't have mussels crawling up our birdfeeder to show us their lures, you know. You have to get underwater to see that stuff. But that doesn't mean they aren't important. But we've discovered in studying this over the last couple of decades is that they really are important and not only that they're super fascinating and provide a lot of value to the ecosystems that we do appreciate.

Megan: So if you could give me like three examples of that value. Go.

Mike D.: Of mussels, you mean?

Megan: Yeah.

Mike D.: Oh, well, I - -

Megan: The rapid fire mussel value.

Mike D.: One of the values that come to my mind first is the fascination value of bringing kids to understand interconnections of nature and their interrelationship between what we do on the land what happens in water. And number two would be what the mussels are doing in the water which is filtering it and cleaning it and creating habitat. And number three for other species like other fish and macro-invertebrate studies show there's more species and larger biomass of aquatic insects where mussels are compared to where they're not. And if you have more of those kind of those critters they're grazing the algae off the mussel shells and the rocks and the fish come in to eat the bugs and people come in to eat the fish. So you know it's all around about thing and if we can keep the mussels in the river they will support themselves because they have this loop. The fish come, they get inoculated with the larva and mussel and they come back to the mussel bed to feed they keep the mussel babe going by dropping juveniles on them. If we can get some dams removed here and there, we would actually reestablish the migratory pathways of these fish and we could restore even more mussels. That's a long-term project. I think in the meantime we're going to try and do it the hard way, the way we're doing it here.

Megan: Bernard, did you have something to add?

Bernard: Yeah. I was going to mention it goes a little bit even beyond that because, you know, the mussels are capturing this food in the water column and the aquatic insects that are eating this deposited food they emerge and then they fly into the prairie and other things in the prairie like birds and spires and things like that eat that and people track them.

Bernard: Yeah, they track the nitrogen.

Mike D.: Good job, Bernard.

((Laughter))

(Several laughing and speaking at once.)

Bernard: I just read that just recently so - -

Megan: It's like he's a scientist or something.

Mike D.: Something. Some kind of ecologist.

Megan: This like brings a little - -

Mike D.: Beyond malacologist.

Megan: I know. It brings a song of mine, It's a Circle - - okay.

Mike D.: That’s true. It all starts with a mayfly hatches on the Mississippi...

Megan: We could talk about mussels with you guys forever - -

Bernard: Yes, forever too.

Megan: and it’s, I mean because it's very, well, it’s a Prairie Pod. It, because it's amazing and it's fascinating and that's why I'm so excited that this is our first episode of Season 3, but we are going to move to our LET’S SCIENCE section.

(Music)

Megan and Jessica: (prerecorded) LET’S SCIENCE, TO THE LITERATURE!

Mike W: SCIENCE!

Megan: So this is the part of the podcast where we recommend a book, a blog or a paper and, of course, we would be remiss if our topic today wasn't mussels. I just want to sing it every time. Mussel, mussel, mussel, mussel, - -

Mike W: Please don’t.

Megan: - - mussel, mussel, mussel. Okay. So we're going to start with Mike. Tell us a little bit about your pick and give us the title of the paper.

Mike D: Oh, did I pick a paper? I don't recall.

Megan: You did. I'll say it. I'll help you out. It's the Natural History and Propagation of Freshwater Mussels by Coker, et.al from 1921, a throwback, if you will. Why did you pick this paper?

Mike D: It was one of the more comprehensive things done up to that point anyway and I read it from front to back when I was working as a fish creel clerk for the fishery section of the DNR in 1986 or seven, I guess. It helped spur my interest in the mussels and their connection between fish and the movement of fish. A lot of what he was talking about was the first dam on the Mississippi River in Keokuk, Iowa. It's a big hydroelectric dam before they build dams for barges and stuff. And it brought a significant migratory pathway of fish and some of them were the only hosts for some of the mussels up here. Ebony shell and elephant ears are our poster child mussel species and probably the Gulf Maple Leaf would fall under that category. But the skipjack herring, our host fish for ebonyshell and elephant ear, they're like, they're a potamodromous fish, opposite of an anadromous like salmon that come in from the ocean spawn. Well, these fish swim up river in the spring all the way out to the prairie rivers, spawn in lakes like Lac qui Parle and the babies grow up during the summer and everybody migrates south because they can't handle our winters. They die up here in the winter. So they go way down below the mouth of the Ohio River or down in that region to spend the winter.

Megan: That's what I would be about.

Mike D: Yeah. And now they can't come back up again because the dam blocks the past. Unless they know how to pull the little cord on the lock chamber in the locker on the dam, they don't get up here anymore. So the mussels have died out. When Bernard and I started doing this, we could still find a few ebony shell mussels in the St. Croix River, but the last time or two we looked all we could find in the river were a few old shells. So we think we've lost them. Until we can restore that migration that species isn't

going to come back here. At one time it was the favorite shell for making buttons. So if we ever want to start another button industry, we better get those fish moving.

Mike W: Bernard, tell us about your pick.

Bernard: Yeah. My pick is a book by Wendell Haag. It was in 2012, North American Fresh Water Mussels, Natural History, Ecology and Conservation.

Mike W: It's a handsome book.

Bernard: It is a beautiful book. You know, I guess maybe you can judge a book by its cover.

Mike W: There ya go.

Megan: (Laughing) Oh, boy.

Mike D.: That's good.

Bernard: Because I love this book.

Mike D.: It's his Bible. Just face it.

((Laughing)))

Bernard: If I need to know something or I'm sort of like, you know, thinking about something and I'm not really sure about that, I go right here and check here first. So Wendell did a really good job of synthesizing all the information, you know, beyond, you know, before NBI and what Coker and those guys did in terms of mussel biology and diversity. It's specific to North America, but he does talk about some European stuff. And it's just got some excellent sections on the historical, you know, very colorful folks and some of the history of freshwater mussels in the country. Mussel shoals and folks like Constantine Rafinesque. He talks about that, but then he goes into lots of other aspects about their life history and in conservation and the things that make them unique. It's very comprehensive. And then he also came up with some new concepts on how to think about mussels. You know, really before this folks thought about mussels as being, you know, they're all the same. They talk about mussels as, you know, in general terms and that could be farther from the truth. We have 300 species in North America and among the higher groups even among species they live their lives very differently. And he pulled that information together to come up with a new concept of how mussel assimilages are structured in rivers, which is really a difficult thing to do. So I would recommend this to anybody who is going to be thinking about studying mussels or just interested in mussels in general.

Megan: See, mussel mania is a real thing. We think that you guys might be catching it. Maddie, tell us about your pick.

Maddie: Yeah. I just kind of went for my go to question book as far as propagation. So this is a fairly new book. Fresh Water Propagation For Restoration. It's kind of a compilation of several authors and propagation biologists from across the country that finally all got together and put their knowledge in one place. And historically it was a class offered out in West Virginia for federal employees. It was this grand booklet where

federal and state agencies could come and learn about fresh water mussels and they finally decided, well, hey, maybe the public should know about this too and really made this accessible to everybody. So it's something that we just look at for new ideas on propagation and really just kind of gives us insights into other people's ideas, opinions, etcetera.

Megan: I like when science is collaborative. I think that's my favorite thing about science. We all pool our knowledge together when we're working on solving these puzzles.

Mike W: Hey Megan.

Megan: Yeah, Mike?

Mike W.: Take a hike.

Megan: I think I will. Or I think I might actually take a swim or maybe a wade or a float. It's hard to say. But because we're doing prairie streams and mussels, I might want to take a float. So this is the part of the podcast where we introduce you to some of your fabulous public lands because yes, you are a landowner, all of you, everyone in the state of Minnesota. You have amazing public landholdings and we want to make sure that we highlight everybody's picks for today. Of course, we limit you to only one and because it's a mussel theme podcast, you guessed it. We ain't hiking on land. We're hiking in the water. So bring your waders, it's going to be a fun ride. So, Mike, tell us a little bit about one of your favorite places. And I do want to mention before you even go that close to this place is the Ottertail Walk-in Access Number 352. So that is the public site that you can visit adjacent to this stream.

Mike D: And if you do, you can step into the water, slip on a mask and a snorkel and see what's on the bottom. In the stretch of the Ottertail that I was interested in there is well over 100 animals per square meter of river bottom and it's like an underwater garden. The Ottertail River's very clear and there are millions of these freshwater mussels. Some of them are quite large, the size of your hand if it's held out flat and they're all filtering and doing their thing. And there is all sorts of greenery in there. It really is a garden. If you look closer, there's aquatic insects crawling around on the shells. You might see a baby mudpuppy crawling around looking for something to eat. If you aren't too crazy and making too much commotion you'll see a lot of fish as well. The Ottertail River is full of fish. One of my favorite places just to go drift down the river watching the wildlife come back.

Mike W: This specific location, it's just east of this walk-in area Number 352.

Mike D: Yeah. It's upstream from Fergus Falls.

Mike W: Upstream from Fergus Falls.

Mike D: Yep.

Megan: And remember when you're accessing this stream you don't want to be trespassing on private land so make sure that you're finding a public - -

Mike D: If you get in at the bridge, you can float down.

Megan: There ya go.

Mike D: But then you have to walk back. That's the down side.

Megan: That's the bad part about any type of river recreation. You have to get back.

Mike D: But you can throw in a canoe at the next public access and then stop along the way here and there.

Megan: Take a buddy in two cars. That's the way to do it.

Mike D.: Yeah. Take a buddy. That's always good in case you choke on some water or something.

Megan: ((Laughing)) We're all about safety here at the DNR.

Mike D: That's right, yeah. Watch out for the bison herds, no wait they're gone.

Megan: Oh, gosh. Bernard, tell us about your pick.

Bernard: Yeah. So mine is Blue Mounds State Park. Yeah, I haven't visited a lot of prairies but we actually went out to this park to survey for the pond mussel, which is a species that in Minnesota only lives in the Missouri River system. And at the park the dam had needed some repair or actually I guess it actually had - - the river actually bypassed the dam because it blew out during a flood. So they wanted to know whether or not there were any pond mussels there. So this beautiful prairie, here it was. It was just beautiful. We drove - - we were driving up to this and it was a great time of the year. I think it was in June and it turned out that the prickly pears were blooming. I had not seen that. I thought wow, they've got cactus out here too.

((Laughing))

Bernard: Yeah. That's why I picked that because it's a very beautiful park.

Mike W: Nice. I agree. Maddie, tell us about your favorite place.

Maddie: I think I have to go to the upper part of the Cedar River. And I say that I don't have - - I'm like Bernard. I don't have a lot of experience with prairies, but this part of the upper Cedar, north of Austin, kind of by Blooming Prairie is really unique for us as mussel biologists because there is a species of mussel there that's really rich. And its unique because it's found in the headwaters of the Cedar River, but kind of south of Austin into Iowa. This population is either diminished or has been completely extirpated. And so with our lab, we've actually partnered with Iowa and we are using the three-ridge mussels from the upper Cedar as a propagation effort to restore three-ridge mussels in Iowa. So we have this really big connection with kind of restoring mussels in Iowa, utilizing Minnesota populations and so that's just one example that we have.

Megan: I love that.

Mike: Yeah.

Megan: As always, this is a little bit different, but for most of your public lands you can find them on the DNR Recreation Compass. You just put that into your Google machine

and type in DNR Recreation Compass and you can find all these things. We will also have them up on our website so that you can find them and some of them are Bridge accesses. Gosh, it's been fun today.

Mike W: I mean, I am a mussel maniac.

Megan: You're a mussel maniac. You've been waiting to say that this whole time. Let's be honest.

Mike W: That's true.

Megan: Like you had that one canned.

Mike W: Yeah. Really, I've gained a new appreciation - - I'm a wildlife biologist, but I knew very little, if anything about mussels.

Megan: And they're fascinating.

Mike W.: They are.

Megan: And we only have so much. So many things. So we're going to continue on this theme next week on Prairie Tuesday where we're going to be learning even more about prairie streams. We're going to talk with Brooke Hacker and Luther Aadland who do a lot of fantastic river restoration work and we're going to talk - - we're going to go right back to Blue Mounds State Park and talk about the restoration there and all the benefits we hope that it's having. And we're even going to learn about some of the scary snake, the great snake save of 2019 that happened. I guess I shouldn't say it was scary. It was actually pretty amazing, but some of the stuff they did to save hibernating snakes. So you're not going to want to miss it. As always, you can find all the resources we talked about today including the Take a Hikes and the LET'S SCIENCE! on our website at mndnr.gov\prairiepod. This episode was produced by the Minnesota Department of Natural Resources, southern region under the Minnesota Prairie Conservation Partnership. It was edited by Dan Ruiter and engineered by Jed Becher. All right. Are you guys ready? On three? Clam-fam! Okay, on three. One, two, three.

All together: Clam Fam!

((sounds of birds chirping and wind blowing))