BONNIE WILLISON: If you looked at Lake Wingra in 2005, you would see a murky, shallow lake clogged with algae. And if you peeked under the surface, you'd see the invasive fish responsible for the green water that people aren't quick to swim in. A century after this fish was introduced, the community around Lake Wingra decides to flip their lake from the murky state that it's in to its alternative state, a clear water state where sunlight can penetrate to it's steps. They were going to attempt to change the biology of the lake by removing one nuisance species.

SYDNEY WIDELL: 300 miles to the north, a group of scientists, we're going to flip another lake. And this time, they were going to try to alter the inherent characteristics of the lake in order to drive out a nuisance species.

BONNIE WILLISON: I'm Bonnie.

SYDNEY WIDELL: And I'm Sydney.

BONNIE WILLISON: And you're listening to Introduced.

SYDNEY WIDELL: And today, Tim Campbell, the aquatic invasive species specialist with Wisconsin Sea Grant is joining us too.

BONNIE WILLISON: Hey Tim.

TIM CAMPBELL: Hi. How's it going?

BONNIE WILLISON: Good. Thanks for being here. So Tim and Sydney, you've worked in Madison. How would you describe Lake Wingra?

TIM CAMPBELL: Well Madison has three lakes and Lake Wingra is the smallest of those three lakes. It borders the arboretum. A lot of people have hiked by it. So it's a pretty popular lake. It's a great place to of take your family out and enjoy the water without a lot of boats zipping by.

BONNIE WILLISON: Yeah.

SYDNEY WIDELL: Yeah. I'd say it's pretty small, and shallow, and weedy. Especially compared to the other Madison lakes. There's a dam on one side that feeds into Linger Creek and then ultimately out into Mendota. And in the spring you can see all the musky coming and trying to jump over the dam. And that's really exciting and a lot of people come out and watch for musky.

I personally have never looked at it and thought like, this is a Lake I really want to go swimming in. But some of my friends were running past and tried to swim across it, and they said that it was kind this scary experience. They could feel so much weediness just grabbing at their legs as they are going across. And my friend said it felt almost like she was going to get pulled under by--

BONNIE WILLISON: Oh no.

SYDNEY WIDELL: --how weedy it is.

BONNIE WILLISON: Yeah. I haven't seen many people swimming in it. I mostly see people like paddle boating in it. Need to try that sometime. But I don't think a lot of these people know about this plan of flipping the lake back in the early 2000s.

SYDNEY WIDELL: What do you mean by flipping a lake?

BONNIE WILLISON: Yeah. So a lake can have two alternative states. And I love these metaphors that lake scientists use. You often hear them saying, pea soup. So one state of the lake is like pea soup state.

So it's murky, and it's algae, and it's green. And the murkiness is usually caused by an abundance of common carp or sometimes other bottom dwelling fish that stir up the sediment on the bottom. And the other state is the salad bowl state. And that means it has clear water and a lot of aquatic plants.

And there's sort of a recipe that you can follow to flip the lake from murky to clear. So you have to start with a lake that's pretty shallow and this lake should have a moderate amount of nutrients. So not too many nutrients, like if it's in an area with a ton of agricultural runoff. Or too little nutrients, like if it's in a cold Northwoods forest. Does that make sense?

SYDNEY WIDELL: Yeah.

BONNIE WILLISON: So next you remove all the common carp. And common carp, they stir up the sediment and they muddy clear water because they can lay a lot more eggs. They can eat basically anything and they are able to live in polluted water. Once you take out the carp, even if you don't get them all, it gives the other fish a chance to rebound.

And it gives the lake a chance to clear out and gets the plants to grow like in a salad bowl. So would this recipe work for Lake Wingra? You might remember Dick Lathrop who told us about Otis and his crayfish in the first episode.

In the early 2000s, Win Dick was 23 years into his career as a scientist at the Department of Natural Resources and he was attending friends of Lake Wingra meetings. Mostly because he's done research on Lake Wingra before. He also thought that he could help them clear up the lake, which is something that they've been trying to do for a while.

DICK LATHROP: The friends of Lake Wingra were having their annual meetings and I was going to them. And they were talking about all the watershed work they wanted to do to clean up their lake. The rain gardens and all these things are great, but I was telling them that if you don't get a handle on the carp problem, the population, the overabundant carp in Wingra, you were never going to see the lake change as far as its clarity, and its algae levels, and all that. I'm not exactly familiar with all the Lake Wingra goals, but I think they wanted clear water that you could stand in and see your toes. So at the second meeting, I suggested that we do a carp ex-closure experiment.

BONNIE WILLISON: This carp ex-closure that Dick proposed was basically an underwater fence designed to keep all common carp out of a certain area, just off the shore. That

way, he could see how the lake would transform over time if the carp were removed. And importantly, the public could see for their own eyes how different the lake could become.

SYDNEY WIDELL: How did common carp even get into Lake Wingra?

TIM CAMPBELL: So I don't know if I could tell exactly how they got into Lake Wingra, but generally, for common carp in the United States, they were brought over as a food source for people settling the United States and also as a recreational fish. Common carp have been pretty important in Europe and Asia. They've been domesticated in Asia for more than 4,000 years and used as a food source there.

And then it's also, I think, a big recreational fish in Europe and Asia. I have a learn how to fish book that was written by somebody in Great Britain, and throughout the entire book, they're talking about this prized carp that they're catching, which I've always chuckled about. Just knowing how people think about the carp in the United States.

BONNIE WILLISON: The US government, the Fish Commission started giving common carp to the states. Wisconsin even placed 35,000 carp in the state, including near Lake Wingra.

TIM CAMPBELL: And I've heard stories of their being aquarium cars on trains traveling across the Western US. And that the fish would just be thrown over the side as the railroad cars went over a body of water. So I think fisheries managers thought that the common carp was going to be this great fish for the United States, because it was a great recreational fish, great food fish. But quickly after it was introduced, people didn't really have the taste for common carp. They didn't like it and it quickly fell out of favor.

BONNIE WILLISON: Yeah. Well, I didn't know people liked to fish for it like, recreationally. That's so funny.

SYDNEY WIDELL: Tim, would you?

TIM CAMPBELL: I mean, I would. They could be fun to catch. And I do know some fly anglers that

really like traveling to the Bahamas for bonefish.

They like practicing on common carp. My grad school advisor, actually, would fish Lake Huron for common carp, because that was good practice for fly fishing for bonefish in the Bahamas. I'm sure some real fly anglers going to laugh at me that I said that, but.

BONNIE WILLISON: Like Tim was saying, things changed after the first few years of carp stocking. Carp were doing really well in our waters, but people started noticing this murky water and less of the fish that they had come to know. And they said the carp didn't taste the same as they did in Europe, where they really like to eat them.

DICK LATHROP: They were planted here in the Wisconsin lakes during the late 1800s.

BONNIE WILLISON: Wow.

DICK LATHROP: And there's a record of somebody noting that in-- I think it was as early as 1906, that carp were causing high turbidity in Lake Wingra. So it didn't take very long for these carp, well adapted to warm waters and fairly fertile systems, to just explode.

BONNIE WILLISON: Back in 2005, Dick needed to prove that taking out the common carp out of Lake Wingra would help. So he and his team built this ex-closure and they left that to the elements and I want to show you the results.

SYDNEY WIDELL: Oh. That wasn't what I was expecting to see. That's crazy. I don't really understand the scale of this photo.

TIM CAMPBELL: Just the scale of that photo-- just looking it up real quick, it's a hectare, which about is two football fields.

SYDNEY WIDELL: But it looks like there is like this super, super murky, green body of water. And it's almost hard to tell where the water hits the shore, because they're pretty much the same color green.

BONNIE WILLISON: Yeah. So it looks like they've put this fence in the water of two football fields and inside is what looks like completely clear water.

SYDNEY Like am I looking to the bottom of the lake in that photo?

WIDELL:

BONNIE WILLISON: I think so. Yeah and the rest of the lake is like green. And the delineation between the two is night and day.

SYDNEY WIDELL: Very stark.

BONNIE WILLISON: Yeah. I've never seen anything quite like this picture. The contrast is so dramatic. And the people of Madison also noticed. DICK LATHROP: We put the ex-closure in the late summer and fall of 2005. 2006, *The Cap Times,* it was *The Capital Times,* which was a daily newspaper at the time, ran a full page. They had a front page photo of the carp ex-closure that just dramatically showed-- this was in August, I think it was, late August, right before Labor Day. They dramatically showed how clear the water was in the exposure, compared to the lake around it. And that just amazed people.

BONNIE WILLISON: When was the last time you saw common carp on the front page of your local newspaper?

SYDNEY WIDELL: I don't believe I have.

BONNIE WILLISON: This got the public excited that they could have a new Lake Wingra. They got behind Dick's plan to flip the lake. So the plan was to remove the carp in the winter, because they determined that the carp always gathered together at the bottom of the middle of the lake during the winter.

So they hired a commercial fisher who came in with the 3,000 foot net. And to get the net under the ice and move it, they used these little submarine things and you would walk the top of the ice to guide the submarines down the lake. And that would pull the net down, and then they could pull all the fish out of the little hole in the ice.

SYDNEY WIDELL: That sounds insanely complicated.

BONNIE WILLISON: I know. When I first heard of that they fished these out in the winter I was just like, how do you do that?

SYDNEY WIDELL: Just many people out there ice fishing.

BONNIE WILLISON: The submarines is a good touch. And they were able to get a whole semi trucks worth of fish out of the lake. So I asked Dick, did the water quality improve after this?

DICK LATHROP: Immediately. Well, I'll say, immediately that summer. And I have a photo of the beach that summer. The water was amazingly clear.

BONNIE WILLISON: And did the people from the Friends of Lake Wingra, were they happy with that?

DICK LATHROP: Everybody loved the cooler water. And the plants had not-- they hadn't had that much time to grow out yet. So 2008, '09, and '10, I think everybody was really happy.

BONNIE WILLISON: With the carp population drastically reduced, the sediment wasn't being stirred up as much so it settled and the lake basically turned from pea soup to a salad bowl over the course of one summer.

SYDNEY WIDELL: That seems like a simple solution.

BONNIE WILLISON: Well, it wasn't actually that simple. There's more to that story. But first I want to hear about Crystal Lake.

SYDNEY WIDELL: So I heard a legend a few summers ago that there were these super smelt living in Crystal Lake, which is this very , small perfectly round lake in Vilas County, which is in northern Wisconsin. And that lake is completely isolated. There aren't any streams running in or out and it's in the middle of this really popular state forest campground.

BONNIE WILLISON: I really like this image of a perfectly round lake, though, with no streams coming in and out of it.

SYDNEY WIDELL: Yeah. It's really beautiful. It's surrounded by these towering white pines and it's just a lovely place. At the time, I knew that smelt were a type of invasive fish, but I had

no idea what a super smelt was. And I didn't understand how they would have gotten into such a remote lake.

GREG SASS: I mean, I don't know if I'd call them super smelt. It's just, like I said, I think when we move into a natural environment, there's variability among individuals of what they can tolerate. I don't know if I'd necessarily call them super smelt.

SYDNEY WIDELL: That was Greg Sass.

BONNIE WILLISON: He's demoting them.

SYDNEY WIDELL: He leads the Wisconsin Department of Natural Resources Fisheries Department, supervises the state's fisheries research program, and he and other researchers have spent almost two decades of field seasons learning how to manage rainbow smelt.

GREG SASS: Yeah. There's really a long history here and I've been kind of involved with smelt removals right from the very beginning of our battle, so to speak. To try to find ways to mitigate the negative effects or eradicate rainbow smelt from a system.

SYDNEY WIDELL: We're going to start at the beginning with phase one, Sparkling Lake. Greg explained that rainbow smelt are a cold water fish native to the Eastern US. They're silver and pretty small, roughly about the length of my thumb to my pinky if I spread out my fingers. But I also have kind of small hands. They entered the Great Lakes through the canals that were built during the 1800s.

GREG SASS: I think the mean of introduction for Michigan, Superior, Huron, was actually they were stocked in a Michigan lake in the early 1900s. And then they escaped into the upper Great Lakes.

SYDNEY WIDELL: Greg doesn't know for sure how smelt were introduced to Crystal Lake, but that lake and a few others in the Northwoods have had smelt since at least the 1980s. It's not like every lake up there has smelt, but the concern is that because some do, if you're a fisherman, you could easily transport them from a lake that has some to like that doesn't. What makes smelt kind of a problem for people who like to fish is that they eat juvenile walleye, perch, and cisco. And they'll compete with them for

other food resources.

GREG SASS: That's where smelts are interesting, is that they're not just at the top of the food chain. They sit-in the middle. And so they're not super specialized, they're more generalized between those two tropic levels.

SYDNEY WIDELL: Which means that they eat both fish and plankton. Crystal Lake isn't the only inland lake where smelt have become established and been really successful. Sparkling Lake, which is a few miles west of Crystal, has had smelt since the 1980s. Since then, the walleye, perch, and cisco--

These valuable sport fish, people really like to fish for them. This walleye, perch and cisco in that lake have practically disappeared. So Greg and the people he works with at this point I just wondering, what would happen if you could just make all of the smelt go away?

Would the walleye come back? Is it possible to return a lake to the way it was before an aquatic invasive got there? So it's 2001 and Greg, who is a postdoc UW Madison at this point, wanted to know what would happen if they took all of the smelt out. The goal?

GREG SASS: To extirpate.

SYDNEY WIDELL: Which meant that they would start netting as many smelt from Sparkling Lake as possible the second the ice came off the water, which is normally when smelt start to spawn. Then they would double down and the remaining smelt by bolstering walleye populations through stocking and fishing regulation. In the first year of that project, Greg and his team netted 10,000 pounds of smelt out of a lake that's smaller than this average size of a Wisconsin farm.

BONNIE WILLISON: That seems like a crazy amount of fish to come out of this little lake.

SYDNEY WIDELL: I know.

BONNIE WILLISON: I mean, I guess it's not little but, wow.

GREG SASS: We did a good job of knocking the smell down.

SYDNEY WIDELL: But as the years went on, they never saw the walleye numbers that they were hoping for.

GREG SASS: Towards the end of it, we were finding that as we knocked those adults down, they just produce more eggs and they really fought back against us in a big way and kind of replenished themselves. And so what we're finding is that we couldn't get in there quick enough with nets, because they're either spawning underneath the ice or spawning before we could actually get the nets in the water.

SYDNEY WIDELL: By taking out all of the smelt that spawned after the ice melted, they may have unintentionally created a smelt population that spawned before the ice came off, which made their smelt removal project so much harder.

GREG SASS: Towards the last years of me leading that project in 2005 and 2006, I was out there with ice chisels in any way possible, basically breaking up the ice, trying to get nets in.

TIM CAMPBELL: I feel like this is a really interesting example of how quickly, selection right, can work in this. Because if you have this curve of when smelt spawn in Sparkling Lake. There was probably the small percentage of them on the early end of the curve that are like, you know what? We think it's worth expending all this extra energy and maybe reduce success. Then we can maybe escape predators, right?

SYDNEY WIDELL: Right. They were able to bring this smelt population down, but the smelt never actually went away.

GREG SASS: They were really resilient. Their behavior changed to an extent And we never achieved eradication.

BONNIE WILLISON: I can't decide if it makes me feel like humans are really small or really, really powerful. Because we can influence an animal population really quickly, but also like--

SYDNEY WIDELL: Yeah. They got duped by the smelt.

TIM CAMPBELL: Yeah. I don't know if I figured out a great way to communicate it, but I always just like to try to impress on people how resilient nature is and things find a way. I think through these examples, just how a lot of things that happen are really random.

SYDNEY WIDELL: Greg finishes his postdoc and there are some missing years where he's working at a field station in Illinois. But in 2011, he gets hired by the Wisconsin DNA and he finds himself back in the Northwoods and in the middle of another smelt removal project, which brings us to phase two, Crystal Lake. Before we get any further, I think it's important to understand what happens in a lake in the summer.

TIM CAMPBELL: When you have a really deep lake, the sun will warm up the top layer of the water but then that energy doesn't get down as far as the entire lake. And so you'll get two different temperatures within the lake. And the top of the lake might approach 70 degrees, where that bottom of the lake will still be around 40 degrees.

And that creates two different layers of water in the lake. And it's pretty well defined. If you have like a fish finder or sonar, you can sometimes see that on some of the sonar on boats. And so you might look at 20 feet or so for the thermocline.

BONNIE WILLISON: Is thermocline the division?

TIM CAMPBELL: Yeah. That's the division. So it's a pretty narrow band where the water quickly changes temperatures.

SYDNEY WIDELL: So imagine you jump off a boat into the water and you're diving, and you're diving. And the top of the water is going to be pretty warm, but then all of a sudden it just gets really, really cold. Like, yeah, you can feel that.

BONNIE WILLISON: Yeah.

TIM CAMPBELL: Yes.

BONNIE WILLISON: Yeah.

SYDNEY So in Crystal Lake, Greg explained that on average that top layer is around 70

WIDELL: degrees. And by the time you're in the bottom waters, it could be as cold as 40 degrees. And around 20 feet is when you have that change in density and it goes from hot to cold.

And rainbows smelt prefer-- you know, they thrive in Lake Superior. They love deep, cold water. So they're not going to be in that hotter, top part of Crystal Lake. So the thought is, if you can't take the smelt out of the lake, can you just change the lake so that no smelt, no self respecting smelt would ever want to live there?

GREG SASS: If we push that temperature up high enough, that should eliminate rainbow smelt from Crystal Lake.

SYDNEY WIDELL: And they were going to do that by physically mixing the lake or never letting it stratify, to bring warm surface waters down to the deepest, coldest part of the lake, or the part where all this smelt were.

BONNIE WILLISON: What do you mean, mixing a lake? How would you even go about mixing a whole lake?

SYDNEY WIDELL: I had such a hard time picturing what was going on, but I found this video on YouTube that kind of shows. You can skip to a 1:30.

VIDEO: The basic idea behind the jelly mixing system is to move large membranes up and down through the water column.

BONNIE WILLISON: Large membranes.

VIDEO: The upward motion of the jellies is controlled by adding air to a bladder that causes them to float. After jellies surface, this air is vented and they sink back down to the bottom of the lake. This vertical movement mixes the stratified lake temperatures and can raise the temperature of smelts habitat by as much as 14 degrees Celsius.

SYDNEY WIDELL: It's not like you can just go on Amazon and say, yes, I would like membranes to do my smelt removal project.

VIDEO: We needed a specialty product, which was a large membrane that would span our stainless steel frame.

SYDNEY WIDELL: People were describing waking up super, super early in the morning to call suppliers in different time zones.

VIDEO: The three of us, on average, probably made around 100 phone calls a day to all these different vendors.

SYDNEY WIDELL: And then there is this period of time where all of these shipments of equipment were coming in to this research station in the middle of the woods.

VIDEO: What are you doing, Brown?

SYDNEY WIDELL: Most of these people are Freshwater ecologists, not engineers. I think that's an important detail.

VIDEO: What are you doing, Chester?

CHESTER: Making butter.

VIDEO: If Jeremy messes this up, the whole project's over. Pressure's on, J.

BONNIE WILLISON: They have like a octagonal frame that they've built and then they're attaching the black jelly part to it. Around the outside.

VIDEO: We're at the Ace parking lot and it's all after Ace closes. It's 11:30.

- What's the good word, [INAUDIBLE]?

- We're done.

BONNIE WILLISON: People are in canoes.

VIDEO: We're putting them in.

BONNIE WILLISON: Wait, what?

[INTERPOSING VOICES]

BONNIE WILLISON: They like put-- like a circle that looked kind of like it was just floating, but now it's like expanding, rising out of the water. The bladder kind of looks like a trampoline,

like the black part of the trampoline in the water.

SYDNEY WIDELL: In the end, you end up with these black balloon like structures floating in the middle of the lake. And then every so often they'll inflate with air. And they'll raise the surface and prevent the lake from ever stratifying. And hopefully then, make it so that the temperatures at the bottom are just a little bit warmer. Because it's bringing that warm surface water down into the deepest, smelt-iest part of the lake.

VIDEO: [INAUDIBLE] Ha, ha, ha, ha. [INAUDIBLE].

- Oh, dude, that is so different.

- Here it is.

- Oh.

- Oh.

- What's up guys? What are you about to do?

- We're going to raise the jelly.

BONNIE WILLISON: Whoa. I'm glad they documented this whole thing with a video.

SYDNEY WIDELL: Someone took a photo from the shore of one of the gigantic black balloons rising to the surface. And it looked like the Loch Ness Monster.

BONNIE WILLISON: I can see that.

SYDNEY WIDELL: Only, in the middle of this public campground in northern Wisconsin.

GREG SASS: Now, I will say the mixing did a really good job of dropping numbers down. So it decreased a number of rainbow smelt greatly, but it did not eliminate them from the system.

BONNIE WILLISON: Wait, so the smelts survived?

SYDNEY WIDELL: What it looked like was that the smell that could withstand the higher temperatures, or at least could figure out how to change their behavior enough to adapt, those were the smelt that survived that summer. And those were the super smelt.

BONNIE WILLISON: Oh my gosh. So after all of that work, there is still smelt in the lake? It seems like they came so close to eradication, but they never achieved it.

SYDNEY WIDELL: Did they eradicate all the carp in Wingra? Or was that even the goal?

BONNIE WILLISON: I don't think it was necessarily the goal, but I'll tell you what happened. Picture this, it's a Friday night in the summer in Wisconsin. There's blues playing on the radio and you're on your way to a fish fry.

SYDNEY WIDELL: Are you getting walleye or perch?

BONNIE WILLISON: I'm a big fan of perch.

SYDNEY WIDELL: Interesting.

BONNIE WILLISON: What about you?

SYDNEY WIDELL: I think walleye, most of the time.

BONNIE WILLISON: What do you get? Pan fried or deep fried?

SYDNEY WIDELL: Oh, pan fried. Completely.

BONNIE WILLISON: Same.

SYDNEY Yeah? Did you know that the majority of the seafood that Americans eat each year

WIDELL: is imported from other countries? By purchasing fish from Wisconsin fish farmers and Great Lakes commercial fishers, you're keeping your food dollars close to home and supporting local family businesses. Our fish producers follow laws that protect fish populations, human health and the environment to produce a sustainable product. Visit EatWisconsinFish.org for recipes, a consumer guide and more.

BONNIE WILLISON: Wisconsin fish, local, healthy, delicious.

SYDNEY WIDELL: Bonnie, I just learned that there's this really beautiful state natural area on Lake Michigan that's just a few miles away from my house, which was so surprising to me. Because I live in a really urban area and I feel like I found all of the parks around me. But this one's called Fairy Chasm, and there's a stream that cuts 100 foot gorge out and drains down into the lake. And apparently it's in it's own little micro-climate zone. And all of these trees that you wouldn't expect to see, unless you're like 100 miles North of here, are all growing in this ravine that's so close to me.

BONNIE WILLISON: Whoa. That sounds amazing. Where did you see that?

SYDNEY WIDELL: I was browsing coastal state natural areas in Wisconsin through the Wisconsin coastal guide, which is this online map that contains all types of information about Wisconsin's fresh coast. From where to find coastal state natural areas, like this one, to the best beaches, to where to see lighthouses, or dive for shipwrecks, or public boat launches. It's a really great tool for locals and visitors and you can explore the Wisconsin coast guide for yourself on the Sea Grant website by visiting, WisconsinCoastalGuide.org.

BONNIE WILLISON: So back at Lake Wingra, about half of the carp have been removed. And that summer it was miraculously clear.

DICK LATHROP: 2008, '09, and '10, I think everybody was really happy. Then the plants started to get out a little more in '11 and by 2012, aquatic plants were pretty dense, and especially milfoil.

BONNIE Without all the carp clouding up the lake, the plants at the bottom of the lake could

WILLISON: finally get sunlight.

DICK LATHROP: So the lake being shallow, aquatic plants just took over.

BONNIE WILLISON: Yeah. Which aquatic plants were those?

DICK LATHROP: Well, OK. There are many, many native plant species in this lake, because it's never had any management. It's never had any chemicals, any herbicides to put in. The Eurasian water milfoil, the exotic, invaded Lake Wingra. Actually, it was first I think showing up in the Madison lakes in the early '60s. I think that's when it was finally documented that it came here.

TIM CAMPBELL: I really would have like that to be a different plant than Eurasian water milfoil.

BONNIE WILLISON: So a lot of times, the native aquatic plants, they'll reproduce with seeds or rhizomes, which are kind of like roots, that can sprout new plants. But Eurasian water milfoil reproduces in a different way. Doesn't it?

TIM CAMPBELL: So Eurasian water milfoil is an invasive plant. It's in more than 800 lakes here in Wisconsin. And when I think about Eurasian water milfoil spread, I usually think of fragmentation. So fragments of it on a boat being brought someplace and establishing that way or a piece of it breaking off in the water column and settling someplace and growing into a new plant that way. But it can also reproduce sexually through seeds.

BONNIE WILLISON: That's pretty big that if you cut up a plant into five sections, that all of them could grow a new plant. I could see how they would reproduce a lot faster than native plants. All of the plants took advantage of the new sunlight, but Eurasian water milfoil took over. It spread to new areas, carpeting the bottom of Lake Wingra.

And it got to be so dense that they had to use water tractors to mow through it, and clear beaches, and cut paths for boats, which is just the ultimate irony to me, that They put all this work into removing one invasive and then another invasive, in this case, Eurasian water milfoil just takes over and you have a new problem. And in the meantime, flipping a lake requires this delicately balanced system. Most lakes are connected to streams and other lakes. And so how would you prevent the carp population from just getting out of hand again and those carp from coming back in?

DICK LATHROP: Well, one of the interesting things about Wingra is that we didn't need to remove all the carp. There are still carp in the lake. In fact, we had a big flood in June of 2013 when Lake Mendota water level went really high and the dam to Wingra got inundated.

I have a photo of it. And people saw-- this was in June. And that's prime spawning season for carp. That it was seen, carp migrating across the dam into Wingra. So the carp densities in Wingra are maybe going back up. But if you have a fishery that's still established, bluegills, it's been researched, particularly by a scientist in Minnesota.

And Have shown bluegills will really suppress carp from successfully spawning. I mean, they'll spawn, but the eggs will be just devoured by bluegills. They love carp caviar. You know?

BONNIE WILLISON: Is there a lot of bluegills in Wingra?

DICK LATHROP: Oh, it's loaded with bluegills.

BONNIE WILLISON: That seems so frustrating to see carp flowing back into the lake again after a flood, after all your hard work. Instead of completely removing all the carp, Dick is saying that you just have to remove enough. Enough that the bluegill will rebound, and they'll eat the carp eggs, and keep the carp numbers down. And this will give other fish, like small-mouth bass, time to rebound.

And theoretically, you have a sustained lake. But it just seems like a really delicate balance, one that could be thrown off by, say a spring flood. So what Dick recommend this lake treatment?

DICK LATHROP: There's reasons to do it, but I think you have to look at each lake to see if it would work. I think we need to look at, in lake management, where it makes sense, but not think that also it is a panacea for everything.

BONNIE WILLISON: The temptation of clear water is real. There's this vision of Lake Wingra that it's clear, and that plants are mild, and you can swim in it all summer without algal blooms. Sailboats can ease across the surface and the occasional angler can motor

around looking for fish. But can this be reality or is this just going to be battle of the invasive species?

SYDNEY WIDELL: So many invasions are the unintended consequences of a well intended introduction. Like people stalking carp in Lake Wingra to make this real fish accessible to the public. But it just goes to show how the way invasions are managed are also fraught with unintended consequences, like opening up a habitat vacuum for a problem plant like Eurasian water milfoil.

BONNIE WILLISON: Or creating super smelt.

SYDNEY WIDELL: Actually, Greg is still trying to figure that one out. And if there were any unintended consequences, they've created opportunities for researchers to ask more questions about what role the smart play in lake ecosystems, which is how phase three starts. Crystal Lake is part of a network of intensely studied lakes around the Northwoods. And every year, scientists do population surveys of the fish on those lakes. And in the years after the Crystal mix, Greg said they started to see something helpful.

GREG SASS: Yellow perch that we're back in Crystal Lake that we hadn't seen, in abundances, that we hadn't seen until-- since the early '80s, when smelt got in.

SYDNEY WIDELL: They were multiple generations of perch. Young perch were surviving.

GREG SASS: And so we said, this is really interesting. We should do something about this.

SYDNEY WIDELL: Is there a way that we can still have smelt in the system, but also see perch and walleye and cisco recover?

GREG SASS: So if we can keep their numbers suppressed enough where they're not having as much pressure and extrapolating walleye, or cisco or perch. Can we keep their numbers low enough naturally through the abundance of native species? Can we keep them suppressed in the long term? Maybe that's the recipe is that we have to have cisco and yellow perch and walleye in the system while we're trying to eliminate smelt, In order to have an effect.

BONNIE That makes sense.

WILLISON:

SYDNEY WIDELL: In future springs, they'll be running experiments to study the smelt populations on Crystal and Sparkling Lake. By conducting some spring removals, they're trying to lower the smelt population, but not eradicate it this time. And hopefully make room for a walleye, yellow perch and cisco to rebound.

BONNIE WILLISON: But he went to such enormous lengths to get the smelt completely out of those lakes.

SYDNEY WIDELL: I asked Greg how his perspective on eradication as an end all be all solution to smelt management has changed over the years. He has been involved in so many attempts to completely remove smelt from a system.

GREG SASS: I would say as a graduate student and still now, I'm a very optimistic person. That where there's a will, there's a way and we can get this done. Through hard work and in some good theory, in our efforts. And I think that's how I would have definitely felt during the Sparkling smelt removal and maybe early on with this.

But as I've grown as a scientist and worked with invasive species more, I've also come to the realization that I think our best case scenario is to-- we always talk about these alternate stable states. For example, we have a clear water state and we have a turbid state. You can only have one or the other. I think there's states that exist in between those, that can also be stable.

BONNIE WILLISON: Introduced is produced and hosted by Bonnie Willison and Sydney Widell. Please subscribe, rate, and review and share this podcast with a friend. You can find Wisconsin Sea Grant Twitter, @UWiscSeaGrant, and on Facebook at University of Wisconsin Sea Grant and Water Resources Institute.

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