BONNIE WILLISON: I'm Bonnie.

SYDNEY WIDELL: And I'm Sydney.

BONNIE WILLISON: And this is Introduced, from Wisconsin, Sea Grant. So when did you first know that there was salmon in Lake Michigan, is that something that you always knew?

SYDNEY WIDELL: I have memories of going down to the Milwaukee River and seeing the salmon coming up the river to spawn. And always being so captivated by these huge fish that were just in the Milwaukee River, which felt not like a big river to me. So I was aware that they were in the Great Lakes, but I had absolutely no idea that there was a weird complicated reason they're there.

BONNIE WILLISON: Yeah. Interesting.

SYDNEY WIDELL: Did you?

BONNIE WILLISON: I did not. I think before I started this job working with Wisconsin Sea Grant, maybe I'd heard that there was salmon in the Great Lakes or that people would go fishing for them, but I didn't know that they're stocked, they're not a natural native fish to the Great Lakes, and yeah. I didn't know about this whole complicated story. So the story of salmon in the Great Lakes really starts with an invasive fish called the sea lamprey. And we've talked about them before, sea lamprey are vampires of the Great Lakes. They are these eel like fish.

So lake trout were the fish that were the top predators in Lake Michigan and Lake Huron, all the Great Lakes before the 1800s. But then in the 1800s, we start opening up these canals that open the Great Lakes up to the ocean. And so that opened up the lakes to any fish that could swim in. Because sea lamprey swim into the lower Great Lakes, they take another canal around Niagara Falls and end up in the upper Great Lakes in the early 1900s.

And at that time in the lakes humans were over-fishing, and we had a lot of habitat destruction. And so after the lamprey came in they essentially wiped out all the lake trout by sucking their blood, and just taking over.

SYDNEY WIDELL: General vampire activities?

BONNIE WILLISON: Yeah. Typical vampire behavior.

SYDNEY WIDELL: In the night.

BONNIE WILLISON: Meanwhile, another invasive species had come up through the canals, they were called alewives. Their small silvery fish that swim around together in schools. And the alewives came from the ocean, so you wouldn't necessarily think they'd be able to survive in the Great Lakes, but they eke out a living and swim farther and farther. They make it into the upper Great Lakes by 1930, and swim into Lake Michigan in 1949.

At the same time you have the vampire lampreys attacking the lake trout, the native lake trout are essentially wiped out of Lake Michigan, and the lake was left without its top predator. The gangs of schooling alewives suddenly had no predators that could keep them in check, and they grow and grow in number. They grow so much that alewives become almost the only type of fish in Lake Michigan, which is not a super healthy system.

And then the die-off started, for some reason some alewives die during spawning, they would die off in these massive numbers. These dead fish would wash up on shorelines and cover beaches. It was a really big problem. People at this time, in the 50s and 60s, were faced with this problem with we have so many alewives there, they're dying off, they're covering our beaches. What can we do about this?

And so there was two routes we could go at this point, I see this as the splitting point of the paths. So one route would be to invest completely in restoring lake trout, the predator that had reigned in the Great Lakes for centuries. Or you could find a new predator, and look towards this new future for the Great Lakes. This was on the mind of one guy, his name was Howard Tanner, and he was this new state fisheries chief in Michigan. And he aimed to do something about Lake Michigan.

Howard Tanner and his staff, they looked to the Pacific coast thinking that maybe one of the salmon species that lives in the Pacific Ocean, that reproduces in freshwater and spend some of their life there, maybe they could survive in the Great Lakes. Howard Tanner and Michigan they didn't consult with Canada, they didn't consult with Wisconsin or Ohio or any of the other Great Lakes states, they just started stocking salmon.

In 1966, the Michigan Department of Natural Resources took coho salmon, which are native to the Pacific Ocean, and sent these young coho out into Lake Michigan. And they also turned to chinook salmon, which are native to the Pacific, although in a more northern part of the coast. Chinook are larger than coho, you might also hear people calling them kings, and that's because they've got a reputation for fighting really hard when you're fishing for them on a rod.

The Michigan DNR started stocking chinook in addition to coho in 1967, and they let all these little fish out into the lake to see what happens. And it worked, the salmon actually did survive, and they actually were able to switch their prey onto feeding on these alewives and there is this salmon frenzy that developed among anglers. I talked to Dr. Fish himself, at least that's what he goes by on Twitter. Titus Seilheimer, he is the fisheries outreach specialist with Wisconsin Sea Grant.

TITUS SEIHEIMER: You know it was like a mania. I think the feeling before that was the lake was dead, fishing is over forever, no one will ever go to the beach again. There's alewives everywhere, they're all dead, it smells. And when this exciting fishery started happening, people were going out, 25, 30, 40 boats, just heading out right at a river mouth catching all these returning fish, people lined up.

BONNIE WILLISON: Yeah. It really drew a lot of people. So it's been 55 plus years since we first released salmon into the Great Lakes, and salmon fishing is still pretty popular today. It brings a lot of anglers to Wisconsin and the Great Lakes region every year. It also strikes me that now we know there are so many consequences for releasing a non-native fish. We talk about those all the time, like what do you think about this decision to release salmon?

SYDNEY WIDELL: Yeah. Well Canada, you aren't going to love this. Yeah. I really I don't envision anything like this happening today. Although not on the Great Lakes scale, but I do hear about people dumping fish that they want into their backyard lake without asking any neighbors. But this seems like that, but on an international scale.

BONNIE WILLISON: Yeah. And that is like-- we really encourage people not to do that very strongly. And so to know that it has happened in the Great Lakes a lot is interesting. But Yeah, it just seems such a risky decision. You've got to imagine that at that time, the science of invasive species was pretty new. The first book about invasion biology was published in 1958. So I was less than 10 years before salmon were introduced into the Great Lakes, and people weren't as cautious about introducing species to new places as we are today.

And so we might make different decisions now, but they were, at that time, faced with the lake that was in pretty bad shape. The Michigan DNR viewed introducing salmon as one of the easiest and quickest things they could do to regain some of the functions of the lake that they had before. So commercial fishers could continue to fish, and tourists wouldn't completely forget about the lakes and write them off. But also knowing what we know now, a more inclusive process to make the decision, like one that wasn't so one sided, would have been good.

Now we've agreed, we have this international agreement between Canada, the US and tribal nations, that we're going to collectively manage the Great Lakes. And that through the Great Lakes Fishery Commission. But it's a little fuzzy for me still, because if Alewife are invasive and sea lamprey are invasive, are these salmon invasive? Would you call a salmon invasive?

SYDNEY WIDELL: I don't know, would you?

BONNIE WILLISON: Well they're non-native, they're native to somewhere else, they are naturally producing in the Great Lakes.

SYDNEY WIDELL: We're checking some boxes here.

BONNIE WILLISON: But part of the definition of invasive species is that, a species is likely to cause economic or environmental harm or harm to human health. And I don't think there's any evidence that salmon cause harm in the way that we are thinking of it right now. And so technically I don't think they're invasive, but you could call them introduced or naturalized. I'm always wondering what is so great about catching these fish?

SYDNEY WIDELL: Yeah.

BONNIE WILLISON: Yeah.

SYDNEY WIDELL: I was wondering that too. I wanted a picture of what salmon fishing looks like 55 years after they were introduced to the Great Lakes. I talked to Barb Carey, she didn't always know about salmon fishing on the Great Lakes, but now she's a captain who takes people out fishing on Lake Michigan.

BARB CAREY: I was actually living in Madison at the time, and I fished a lot and I saw my neighbor around the corner had a great big cooler full of salmon in his truck. He just got home from a trip and I'm like, where the heck did you get those? And he said, Lake Michigan. Well at that point, that was probably 15 years ago, I had no idea Lake Michigan was full of salmon that I could go catch.

SYDNEY WIDELL: She's an avid angler, but she's also a teacher. She founded a club called Wisconsin Women Fish, and also founded the Women Ice Angler Project. If you're just getting into salmon fishing for the first time, Barb says you don't need a fancy boat, you can catch fish from the shore, bridges, in the spring or fall when the fish are migrating upstream. But there are two other ways to fish for salmon, the first is out of kayaks and the second is in large boats out on the Great Lakes.

You can hire charter captains to take you out on the lakes to catch fish. Back in the day, Barb and her friends hired a charter boat to try out fishing on Lake Michigan.

BARB CAREY: Well the first couple times I went out, I went out on a charter. And that was fun, it seemed overwhelming to me, but I brought some fish home, had a fun time with my friends. But when I walked away from that, I didn't feel like I knew anything more about salmon fishing than when I got there. We were kind of visiting with our friends and waiting for the next bite and then you'd get a bite, and then they would hand you the rod and you'd reel in the fish. And everyone would celebrate, and then it was your turn every sixth time, because they can take six people.

So I was running a big boat and I had been fishing Green Bay, and some other bigger waters. And I thought, well, there's no reason I can't take my boat out here. So I just started asking around and started going forward, and I didn't know anything, and I didn't have the right gear, I was just mainly using my walleye gear. And then it was really a struggle to catch that first fish, but when I did, it was so exhilarating and so amazing, and I love being on Lake Michigan.

I mean, there's nothing like it. It's like a different world. The world is so crazy and chaotic, and out there it's just you, a bunch of water and some fish. So I'm a big water person, I love big water. I know it's intimidating to a lot of people, but for me, that's what I like.

SYDNEY WIDELL: Barb's been fishing on Lake Michigan for the last decade, she's improved a lot and is always learning.

BARB CAREY: I'm pretty proud of that accomplishment, especially since I don't see any other women doing it. I got my captain's license about three years ago, so I've been using that with being able to take women out and showing them how to do it.

SYDNEY WIDELL: If you did hire Barb to go out on a trip, she'd first give you a safety talk, after all, you could be 10 miles out in the middle of Lake Michigan where the water is freezing cold, and if something happens you could be in danger.

BARB CAREY: I usually have a plan ahead of time where I'm going to fish, and we go start setting lines, and if we don't get bites we change direction of where we're gone. There's so many little details that matter out there, like the angle that you go, the angle that you're driving. You would never think that that would be a big factor, but it is.

SYDNEY WIDELL: One of my biggest questions was, what does it actually feel like to get that fish?

BARB CAREY: The thing about salmon fishing, no matter how you're fishing, shore, boat, kayak, whatever, when you get a bite, it is so forceful and so intense, there's times when you feel like the rod is going to be ripped out of your hands. If the rods are in a rod holder, that rod will just start pounding in that rod holder. And sometimes it's even hard to get the rod out of the rod holder, and so that level of excitement, that's what puts you in this state where your heart is pounding.

You know it's going to be a huge fight to get this fish in, and there's a lot of things that have to come into play for you to get it in the boat. You've got to net it right, you need a good net person, you need to maybe move some other lines out of the way, you're still driving the boat. So it's a very active, and it's very thrilling, and it's just addicting. Although I still enjoy panfish fishing, it doesn't bring that level of excitement that salmon fishing does. It's so intense, and it's so ferocious.

SYDNEY WIDELL: I was also wondering how that compares to catching a native fish like lake trout for example. After our lake trout reigned Supreme before the 19th century, what was it like to catch them?

BARB CAREY: Well lake trout are known as more of the lazy log kind of fish out of Lake Michigan. They're probably the least of the fighters, when you have rainbow trout and you have king salmon, or chinook salmon and coho salmon, the lake trout fight the least. But they're probably the most plentiful to catch, and they're fun, they're huge, you can get some-- I've got some really, really big ones.

SYDNEY WIDELL: Barb is just part of a whole fishing industry. This new recreational fishery that was created in 1966, has become a huge part of the Great Lakes economy.

BARB CAREY: The fishing industry is a huge economic benefit to Wisconsin, and millions of dollars go into the State because of fishing, recreational fishing. And when those numbers start going down, and those cuts are made, people notice.

SYDNEY WIDELL: The recreational fishing industry is pretty big as a result of stocking salmon and trout.

BONNIE WILLISON: The Great Lakes commercial recreational and tribal fisheries are collectively valued at more than $7 billion a year.

SYDNEY WIDELL: There are businesses that rely on stocked fish, like Barb's, being a charter captain. Lots of people from around the world come to the Great Lakes just for this kind of recreation.

BONNIE WILLISON: It seems like this economy and tourism, and just the fishing traditions are really dependent on how many fish we stock then.

SYDNEY WIDELL: Yeah. How are we making decisions about what type of fish we stock every year, and were we're stocking them, and how many of them are going to stock?

BONNIE WILLISON: We have salmon in the Great Lakes because we're still putting them in every year. Which is a fact that blows my mind every time I think about it. Eggs are raised in hatcheries across the Great Lakes, and we have three in Wisconsin. I talked to Brad Eggold, he's the Great Lakes district fisheries supervisor at the Wisconsin Department of Natural Resources. And part of his job is to supervise stocking in Wisconsin.

So in 2020 for example, Wisconsin stocked 1.2 million chinook and 500,000 coho salmon in Lake Michigan. And I was just curious of, how do you start this process? If you want to put 1.2 million fish in to a lake, how many eggs do you need? And for that, Brad said, he relies on the fish culture team.

BRAD EGGOLD: So they know the different life stages of these fish. You've got you're how many fertilized eggs are produced, and how many of them appropriately eye up and start to develop. And then how many of those will translate into small 1 inch fish. And then how many of those might survive to be 6 inch or 7 inch fish. And so then they basically back calculate that and say, OK, to produce 1.2 million chinook we might need three million eggs.

SYDNEY WIDELL: Three million eggs.

BONNIE WILLISON: So as I mentioned the DNR has a handful of hatcheries that raise chinook and coho salmon. They'll get eggs, and the eggs hopefully hatch. And so as they grow they're moved from tanks into raceways, which are like a swimming pool lane that could be outside or inside where the fish can swim around. And it seems like a challenge, it's kind of a 24/7 job to look after fish. Like any animal, like you need to make sure that the technology is up and running at all times, the chemicals are good, there's no parasites and there's no diseases that are threatening you.

After a few months the little fish are ready to be stocked. Before they're stocked in the lakes, they're all marked. With most of the chinook that are stacked into Lake Michigan now, they have their adipose been clipped before they go out into the lake, so you can clearly tell which fish came from a stalking situation, and which ones were born out into the lakes. And some of the Wisconsin fish are also tagged with this coded wire tag, which is this super, super tiny little wire that is put into the snout of the young fish.

The wire is so tiny, it's like a speck on your hand, like 1 millimeter along. The wires are coded with information, so they have, what year they were stocked, and who stock them, and where they were stacked, all onto this little wire. So this is all interesting, but to think about how they actually accomplish this is pretty wild. So imagine like-- because these fish are like the size of minnows, like how would you get one million wires into one million minnows?

So the US Fish and Wildlife Service actually has the special trailer, it looks like a trailer you might see at a campground, where you can drive it around. And so they've got this automated process where the fish go through the trailer, and people don't even have to touch them. I think when they swim into the machine, they're strapped down in there for a hot second, and their fingers clipped and the thing is inserted into them very quickly.

SYDNEY WIDELL: OK. So in summary, baby salmon are super small, but the chip that gets put into their snout--

BONNIE WILLISON: Yeah.

SYDNEY WIDELL: Yeah. Into their snout, is incredibly small. And a machine does the entire thing and it's wild.

BONNIE WILLISON: Yeah. So when it's time to actually put the fish into the lakes, they oftentimes do it with the truck, so they'll corral the fish and net them into this truck that is like a dump truck, but it's got a tank on the back with water in it. So the fish are put in there, they drive to different rivers and streams and they put out this pipe, and then they basically pump fish into the river or the stream. And when I was watching videos of this, it looked like a fire hose, but like what's coming out is just thousands of minnows, little fish.

Sometimes they're also pumped into net pens, which are these cages that rest in the water, and so then the fish can live in there for a little bit before swimming out. And those are usually sponsored by fishing clubs. Then the little fish are home free in their stream, but they're really small. Here's Brad again.

BRAD EGGOLD: You know these fish get stocked out in a relatively small size, we're talking 6 inches, 7 inches. It's really hard being a small fish in the Great Lakes, in particular Lake Michigan. It's, you're really fighting and battling to get enough food to survive, primarily because of these quagga muscles that are there, that are filter feeding out a lot of the nutrients out of the water. So here a small fish, you've got to really be efficient.

The smallest fish, ironically, that we stock is this is the chinook salmon, because their life history, they get stocked like two or three inches. And the chinook salmon is a phenomenal fish, a phenomenal predator, a phenomenal fighter and if we would stock, for example, rainbow, coho, brown, if we would stock them at the size we stock chinook salmon, we would hardly see any fish survive.

BONNIE WILLISON: The ones that do survive, they continue to grow and they go through smolting. This process called smolting, which is--

SYDNEY WIDELL: Not to be confused with smelting.

BONNIE WILLISON: Yes. This is usually when their bodies are getting ready to go out into saltwater in the ocean, and then they also lose these stripes that they have. They become more silvery, and then they head out to the lakes.

BRAD EGGOLD: The great, great grandfathers of these fish were out in the Pacific Ocean. So they're geared for swimming thousands of miles in a blink of an eye, it's nothing to them. Lake Michigan is small compared to that, so they're moving up, chinook and all these fish swim easily around Lake Michigan, Lake Huron with no problem at all.

SYDNEY WIDELL: Jealous of that power?

BONNIE WILLISON: So then they need to find something to eat. Coho salmon, they mainly eat alewives, but they also eat some invertebrates. But chinook, they only eat alewives, which I found surprising, like really, you only one type of food? But yeah, it's basically only alewives. So they feed for a few years, they grow a lot, they go from being a few inches when they're released, to like four or five months later, they're like already a foot long.

And then it's time to spawn. Chinook don't spawn until they're four years old, usually. So the baby fish that we stock say in 2020, they won't be coming back until 2024. So when they return to their home river and they spawn, the females will make little gravel nests and sometimes their eggs do survive in the wild here in the Great Lakes, it has a lot to do with the water that's around, or the land the water is coming from.

Here's Titus from Wisconsin Grant.

TITUS SEIHEIMER: The State of Michigan, lower peninsula Michigan, has just a ton of very forested watersheds now, lots of watershed restoration, clear water, well oxygenated, good habitat over on the Michigan side and that's where all these natural reproduce fish are coming from. For us over here, we've got a lot of agricultures, that agriculture means a lot of sediment runoff, a lot of not good habitat.

BONNIE WILLISON: In Wisconsin, we have a handful of streams on the Lake Michigan side where salmon will naturally reproduce and survive, but we don't really have that many. A key fact in this process is where do they get the eggs for the hatcheries? And to get the eggs for the hatcheries, we actually have to capture the spawning adults that are coming back for their eggs, and their milt.

So essentially, the DNR has to squeeze these migrating fish every year in order to raise next year's fish.

SYDNEY WIDELL: I'm trying to process that, like actually squeeze the fish. Oh my God, that's brutal. You know they're working together though, that seems, it seems intense but they both have the same goal here. Which is to continue salmon-kind.

BONNIE WILLISON: Ah, it's really true. Yeah. After the break, I get to go see this process for myself. Picture this, it's Friday night, you're getting ready to cook fish for dinner. It's some of that fresh rainbow trout raised right here in Wisconsin.

SYDNEY WIDELL: Does it matter where the fish comes from?

BONNIE WILLISON: Yeah. It does. Purchasing fish like rainbow trout from Wisconsin fish farmers, or lake whitefish caught by Great Lakes commercial fishers, keeps your food dollars close to home and supports local family businesses. Wisconsin's fish producers follow laws that protect fish populations, human health and the environment. So that they can offer you a sustainable product. Fish are easy to cook and nutritious. Visit, eatwisconsinfish.org for more information and to find recipes.

SYDNEY WIDELL: Wisconsin fish, local, healthy, delicious.

BONNIE WILLISON: The Root River Steelhead Facility is one of the three facilities on Wisconsin's Lake Michigan coast where they collect salmon eggs, and they also do trout and steelhead eggs too. The facility is in Racine on Lake Michigan. And as I was driving in it looked like I was just going into a city park. There was the Root River meandering through the park, and then when I parked, I saw this outdoor pavilion with a fence around it and some signs. I just got here and started raining again.

Immediately when I got out of the car, I heard people in the distance shouting, female coho, male coho. So I walked down to the river first, and I went to the part that was upstream of the facility. And I saw like eight, nine people fly fishing like waiting. I could also see these big fish inching their way upstream towards the facility. Right in the middle of the river, it was a very shallow river.

SYDNEY WIDELL: Little did they know.

BONNIE WILLISON: What they were getting themselves into. Yeah. The fish that are migrating up the river meet this dam right before the facility, and the only way for them to get across the dam, is to pass through this fish ladder that's like little channel that bypasses it. And so once the fish go into the ladder, they're kind of in this moat that's around the pavilion. And the fish collect in there until the processing days, there's no way for them to get out.

So I walk up to the facility, and I see like six or seven DNR people in rain gear and masks walking around in there with a lot of bins and a lot of really big fish. Looking in and I can see these bins of really big salmon, like the size of an arm. And they seem to be measuring them and hauling them off to this truck, but I was confused because the salmon don't seem to be moving.

The fish in those bins are they knocked out?

SPEAKER 1: Those ones look very soft, [INAUDIBLE] and the only way we can get that tape back is to remove their heads so.

BONNIE WILLISON: Oh.

SYDNEY WIDELL: Oh no. All the poor fish. Yikes.

BONNIE WILLISON: And I look over and I see this tent that I had not seen before, and it's kind of behind the pavilion, I just look over and see them sawing a giant fish's head off. And they're using this drill, drilling into it's head. I think maybe they're taking out the-- oh my God, they chopped another head.

SYDNEY WIDELL: Bonnie were you expecting that at all?

BONNIE WILLISON: I had no idea. It was very shocking and there would be sawing so vigorously at this fish's beak that the jaw would just like fly off the table. They were removing the head or they were drilling in and taking a core of the head, in order to get access to that tiny metal wire tag, to get the data from it. And if you remember from the beginning, they put these tiny coated wire tags into some of the young fish, and the tags include a lot of coded information and data.

And those tiny fish were grown up now, and those are the ones that were in front of me. And their heads are taken to the lab where the wires are removed and analyzed. So even though it was a little surprising to see them in the action of collecting the tags, and I'm not a fish persons, so I'm not really used to that kind of stuff, it was still really interesting to see. It's really cool to imagine the data that you can get from these fish, you can tell once you have that tag if they were stocked from somewhere else, and they've just swam all the way over to our shore.

Like they could have been stocked in Michigan, Illinois, Indiana, they could have come from Wisconsin. Or they could have been stocked all the way in Lake Huron. Like this is the way these scientists were checking in on the health of the fish population. After that I went back to the pavilion to see if they were doing anything different, and this time they were working with fish that were definitely alive. So there was this fish elevator, it seemed like, that was bringing fish up from the moat.

And then the fish would slide into this metal bin. This was the carbon dioxide, tank so where they put the fish to stun them for a little bit, so they're easier to handle. The carbon dioxide tank, apparently, it knocks them out a little, it takes a little bit of the fight out, but not a lot, because then it looked like they were taking the fish out to weigh them and to measure them.

But seriously, every fish that they grabbed, they would drop. So they were getting these huge fish out, the fish were flopping everywhere, they were dropping fish everywhere. It was a funny sight. Also something that surprised me was that immediately when they grabbed the fish out of the water, there would be a stream of eggs coming out of the fish, or sperm. I didn't think it would come out so freely, I thought there would be some squeezing involved, some squeezing needed to get the eggs and sperm out.

But they were falling everywhere, the whole floor of this pavilion had these pink eggs on it. I was standing there staring at them for so long that this guy came over to me with this chinook salmon that was like three feet long in his arms, he was like, Do you want to see one?

SPEAKER 2: This is the chinook salmon. Chinook salmon is their common name, and this is what, a 20 pound female? So we're done with chinooks, we have enough of them.

BONNIE WILLISON: So it turns out that they were done getting eggs and milt from chinook, and they were planning to get the eggs and milt from coho next week. So I missed that, but the fish had been collecting for weeks since they had last been there, and so they still have to process each fish and pass them on to the other side of the river and take measurements. And I guess they were taking 50 to 75 snouts as well. The Root River Steelhead Facility has been running since 1996, Brad Eggold, from the DNR, has been spawning fish there all that time for 24 years. Since it opened.

BRAD EGGOLD: Once they're in the facility the only way out is if we grab them and move them along, they can't get out any other way. As we joke around the first x number no fish are fun and then you end up grabbing fish after fish and it gets tiring after a while. You end up grabbing these fish like two or three times, and as far as chinook goes, yeah, their average weight's got to be 20 pounds.

So 20 pounds times 100, that weight starts adding up in a hurry. We had one year, some time ago now, where we end up running 30,000 chinook through the facility. And you start going like, well there's a average number of people and we have to handle these two or three times, Oh, I just handled like 50 tons of chinook.

BONNIE WILLISON: You just squeeze the fish to get the--

BRAD EGGOLD: Yeah. On the females we do squeeze the fish, we also have air, where we inject air into the body cavity to help us get all the eggs out. And then males it's a manual process.

BONNIE WILLISON: So they would put the eggs and sperm in a stainless steel bowl and stir it, and then the eggs are fertilized and the cycle starts all over again. So we've got these Great Lakes that have just been turned inside out by invasive species, and this whole web of introduced species, from the sea lamprey to the alewives, is how we got to the salmon fishery in the first place. And we obviously put lots of effort into maintaining the salmon fishery.

So for decisions like stocking numbers, like how many restock, we definitely have a more collaborative approach now. At the top of making decisions about stocking is the Great Lakes Fisheries Commission. They have meetings to talk about the Great Lakes issues as a whole. And so they talk a lot about the status of sea lampreys, are they in check? How many prey fish do we have to feed? Any predators? And are there any other emerging issues, like invasive species? How are the lake trout doing?

And then they have groups that focus on each lake. Those groups have State representatives, representatives from the Canadian Provinces and Tribal reps. And they look at the science, specifically to that lake that they're focusing on, and they think about the stakeholders that they know pretty well. From there they put it all together and make recommendations for how many fish should be stocked in the lakes each year, and then those recommendations go back to the States and the Provinces.

So there's a total number for the whole lake, Wisconsin will be responsible for stocking this many fish, so it's broken down free for each State and Province.

SYDNEY WIDELL: So no one's just going out by themselves and dumping a bunch of salmon into the lakes anymore, that can't happen, is what you're telling me?

BONNIE WILLISON: Right. Brad Eggold is the guy who works on the Wisconsin side of this issue. So within Wisconsin he is the Great Lakes District Fisheries Supervisor for the DNR. And I'm struck by how big a job this is, like just go out and manage Lake Superior and Lake Michigan for the State, no big deal.

BRAD EGGOLD: It's quite an honor to work on the fish, there's a lot of responsibility, we've got a lot of great staff.

BONNIE WILLISON: So to get at the number of fish that Wisconsin is going to stock, so for example, say we want to stock 1.2 million chinook for the next three years, they have to look at the science. You need to know how big are the fish that are coming back, how many fish are being caught every year, how many fish are naturally reproducing, like how many are out there in the streams producing on their own. And so that will affect the stocking levels.

A really important question in all of this is, if we're stocking fish will they have enough to eat? Because these chinook and coho are predators, if they eat all the available prey, the whole food web would crash.

BRAD EGGOLD: We've done a lot of diet stomach analysis on these Pacific salmon and trout, and when it comes down to it, they just love eating alewives. Whether it's easier to catch, they're tasty, I don't know, but they really target eating these alewives. Particularly, chinook and coho salmon.

BONNIE WILLISON: This is all good, it's why the salmon ended up in the lakes in the first place, is to eat alewives. And it's all good as long as there's enough alewives in the lake. They're really dependent on this one species, but the alewives are dependent on the nutrients that the mussels, the zebra and quagga mussels, are now slowly sucking out of Lake Michigan. Alewife numbers have gone down.

Recently in the past decade, we've seen near record low levels of alewives in Lake Michigan. So the good thing about having five Great Lakes, is that you can compare and contrast what happens in each one. So Lake Huron and Lake Michigan are like sister lakes, they're actually technically one lake, so it's interesting to compare and contrast them. So in Lake Huron, in the 80s and 90s, things were going well, they were stocking a lot of chinook and those chinook were doing great, and they were reproducing at pretty high levels.

But then in 2003, the alewives crashed, and Titus walked me through this.

TITUS SEIHEIMER: Lake Huron is sort of your worst case scenario. Right around 2003, alewife numbers which had been relatively stable, maybe declining long-term, just crashed. And for the anglers over there, they started seeing these like starved chinook salmon. And so what that looks like is their head doesn't shrink, they have this huge salmon head, but then this really super skinny body. And that's what started happening.

BONNIE WILLISON: It's been more than 17 years since that happened, but Alewife are still few and far between. They haven't recovered, they have had a little increase in their numbers, but not a lot. But on the flip side of this, we saw some positive effects on native species like the bloater chub, numbers have increased a little bit. And lake trout, whose numbers were suppressed, they're actually doing pretty well, we were stocking them because they weren't able to reproduce on their own very well.

But we're getting to the point in Lake Huron where stalking won't be necessary, because they're doing so well. But Lake Huron is still stocking salmon. But it's interesting because when the fish are stocked, they apparently make a left turn and live their whole life in Lake Michigan.

SYDNEY WIDELL: They know--

BONNIE WILLISON: And then--

SYDNEY WIDELL: They know where the good break is. Yeah.

BONNIE WILLISON: Yeah. I guess they know where to get the food. And so you can only really catch them on Lake Huron, in the fall when they come back there to spawn. Then we move to Lake Michigan. Lake Michigan had peak alewives in the 60s and 70s, when we had so many that they were dying off and washing up on beaches that stretch for miles, causing a real problem. Salmon were stocked and they started eating the alewife, and so over time the alewife declined.

And over the past decade, they've gotten really low. So there's a big discussion right now about predator versus prey. And the main objective is really to avoid what happened in Lake Huron. As I was researching this story, there was just a lot of articles, and blog posts and stuff about this dreaded time in Lake Huron in 2003, and how Lake Michigan compares and contrasts.

SYDNEY WIDELL: Where are the salmon? Yeah.

BONNIE WILLISON: In Lake Michigan, stocking has lowered over the years. Because we're trying to keep up with what the lake can support. If we stock too many fish and they eat all the Alewife, there's a really high cost there, there could be a complete collapse and all these businesses and tourism would really struggle. As a culture, we've fallen in love with salmon, they're fun to fish for, they support our tourism economy, they're delicious, but their past and future are completely tied to other species that we really don't love.

Which brings us all the way back to the sea lamprey, the sea lamprey set off a chain of events that leads to the alewife boom, and culminates in humans flying a few Pacific fish thousands of miles to stock our freshwater seas. And species introductions haven't stopped, zebra and quagga mussels now coat the bottom of Lake Michigan. A tiny crustacean, called the spiny water flea, is disrupting food webs from the bottom up in all five Great Lakes.

50 years ago we were asking the question, how do we use salmon to control the invasive alewives? The lakes have changed, our priorities have changed. And now we're asking, how do we preserve the alewives to save the salmon? Introduced is produced and hosted by Bonnie Willison and Sydney Widell. Please subscribe, rate, review, and share this podcast with a friend.

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