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[00:00:00] **Speaker 1** So walk me through the science of what we have here and what step in the process we're in.

[00:00:08] **Speaker 2** Okay, so we're at nearly the beginning. We're kind of at the midway point here. So typically what we do is we have, usually we have the spears collect the fish for us, and we pay usually $10 a fish or so. And then we try to get at least 12 per lake where we're aiming. And so that doesn't always happen. Sometimes we collect the fish through population assessments. And that's the way we got these, and these came from Michigan. From our sister agency, KVSC, and so we're assessing, right now we're assessing the mercury content of the fish as well as the PFOS content of the fish. And I say mercury, but it's actually methylmercury. There's a big difference there. A lot of people, whenever you speak on that, they think of the inorganic metal, when really we're dealing with the organic metal, which is a mercury that has been methylated by typically anaerobic bacteria. In, say, a marshland or a bog. So the factors that contribute to that are your levels of sulfate, your pH contributes, and as well as the dissolved oxygen. So as anaerobic bacteria work on this stuff, a lake with lower dissolved oxygen, acidity, higher acidity and then potentially higher sulfates, you'll see an increase in methyl mercury in those fish populations.

[00:01:34] **Speaker 1** So it's important for you to study different links, because even if they're next to each other, links may be different, right?

[00:01:40] **Speaker 2** Yes, that's exactly right, and we're also monitoring trends over time. So this program has been enacted since, I want to say 1996 or so, and so it's been going on for nearly 30 years at this point.

[00:01:52] **Speaker 1** What have you seen over that time?

[00:01:55] **Speaker 2** Actually we've seen the trends are steady. They follow what you would expect, you know, larger fish by accumulation. They tend to have more methylmercury content. Right now the focus is actually towards PFOS. We're trying to detect hot spots and so with the fish you not only are you making a food consumption advisory. To let people know if the fish are safe to eat within that lake, but also we are at the same time looking at the quality of water, because if your water is contaminated, your fish will be contaminated as well.

[00:02:36] **Speaker 1** What are the main concerns with methylmercury? Obviously, the consumption is the issue.

[00:02:42] **Speaker 2** So your main concerns are it is a neurotoxicant or neurotoxin. So with methylmercury, it is very toxic to our special populations, to women who may become pregnant, women who are pregnant, children, infants, newborns, anything that has a developing brain. Is highly susceptible to methylmercury toxicity.

[00:03:15] **Speaker 1** And are people more aware of these? I mean, I've obviously been doing this study a long time. Are people becoming more aware that they should take that seriously?

[00:03:22] **Speaker 2** Ah, more aware, we need, all right, so more aware. They are aware, but as far as like the intricate details of it, I would say no, we are, we need to do more on that part. Like I said earlier, a lot of people believe it's like the liquid metal mercury, but no. Here we're dealing with a organic form of mercury. In fact, a lotta metals, if a metal is safe, take tin, for example. If you stick a methyl group, a couple methyl groups on tin, that metal goes from a safe metal to a quite toxic metal. So organic metals are typically something to always be concerned of.

[00:04:04] **Speaker 1** And mercury is found everywhere in the universe, right? But yeah, mercury is a natural...

[00:04:07] **Speaker 2** Mercury is a natural occurring compound. When Marcus was speaking on earlier how there is atmospheric deposition of mercury, that's just something that happens naturally from combustion of fossil fuels, combustion of anything that's going on in the industry, goes up into the air, and then it slowly will out and then it's there's a they have this model there's people put this down to a math and then And so usually where there's a higher concentration of industry, you can see more mercury deposition. In the past, whenever the United States was in its industrial age, like we were making metal manufacturing back here, that's when the levels were higher. They're looking at, what is that bay called out of Duluth? St. Louis? St. Lewis River Estuary? Yeah, so they're monitoring that. Keeping track of those levels because that's a lot of industry in that area.

[00:05:10] **Speaker 1** We saw one of the fish where we saw a lot of the other fish popping out of her. Just talk about that food prop. OK.

[00:05:16] **Speaker 2** Okay, so the bioaccumulation. So, you know, once the mercury is deposited into the soil, the water, it then becomes part of the, you, know, the natural cycle of things. It is taken up, you know, you imagine like a little bacterium. They just suck that mercury up, methylate it, send it out, you now, and sometimes it can even become double methylated. So you have methylmercury, but typically the equilibrium tends to fall on the methylmercahy side. So once it's deposited, the anaerobic bacteria, bacteria get a hold of it and then the peat and the marsh and the bog and the soil. Slowly gets accumulated up through, let's say, the Daphnia, the little water fleas, the little water bugs, and then they accumulate it and then you have the little fish come and feed on those, and the little fishes get fed on slowly but surely by the larger walleye and then, you know, up the food chain it goes. And so you have a bioaccumulation effect, a magnification of methylmercury in, say, your larger, older fish.

[00:06:23] **Speaker 1** And that's why there's always the warnings about the size of the fish and the size of the flake.

[00:06:27] **Speaker 2** Exactly so that's where yes, that's exactly where the warnings come about regarding the size of the fish and The age so you typically want to stay below 20 inches on your fish size for eating The sweet spot I would say is around 15 inches to 18 inches That's your sweet spot for eating and safety. So what do we know about?

[00:06:48] **Speaker 1** Of Peafox.

[00:06:51] **Speaker 2** It's a developing field at the moment. It is, we are learning it is a compound that we are detecting in extremely small quantities. That's why we have the foil there to help with any cross contamination. What we know about PFOS is it's another forever chemical. Just like PCBs, PFOS will be around until we're all dead and gone. It'll be around forever. And so we're monitoring, all right, let's start where we know, so PFOS, where we expect to find PFOS are runoff areas around landfills, airports, and firefighter training areas. Those are our three main hotspots, so if you live anywhere around there. And not not say per se a modern landfill because now they're being designed to control for that but an old landfill that doesn't have per se the liner you would have runoff you see from the leachate off of that landfill and that leachates would lead into the waterways and then you would see from that fish, hopefully first, testing that area increased amounts of say PFOS. So PFOS is a catch-all umbrella term for many per fluorocarbon chains. So the main culprits we're looking at are PFOS, P-F-O-S, and PFAS, P-F-A-S for right now, there are many others. 15,000 or so to be exact or more

[00:08:30] **Speaker 1** So, but are they, do we know if that's equally distributed in every element of the water and the fish and the meat?

[00:08:37] **Speaker 2** Uh, no, it's not equally distributed. Um, like I said, it, like you have your hotspots, right?

[00:08:44] **Speaker 1** But I guess if there's a run-off area, isn't all the fish that come through there, or is that what we're still trying to figure out, whether it's in the filet or if it's constant?

[00:08:52] **Speaker 2** Yeah, so we do have data on that, that comes from Gavin, our PFAS guy, he's in Madison. So he has data that states that the PFAS is concentrated in the head. And he thinks it's the wildlife cheeks, but I disagree. I think it's stuck in the brain, because it's a fatty molecule, but it's not. I believe it kind of mimics cholesterol, and you know, your brain is high on cholesterol. Or it tries to, it gets incorporated there.

[00:09:27] **Speaker 1** But that's where the science, we need to know more.

[00:09:29] **Speaker 2** We need to know more, so honestly if I want to write a grant, I would write a grant for Marcus to collect brains and we would sample those brains and see if the PFOS is actually concentrated, but first we have to find the hot spot to find where these PFOS concentrated fish are. We do have a few lakes that we know that are hits and so once we have those we can actually focus on those areas and then focus on the fish in that ecosystem to see how that PFOS actually is. If it is accumulating, where is it accumulating? Is it in tissues, is it in certain organs, that sort of thing.

[00:10:03] **Speaker 1** It's possible that taking a filet sample to look for pithos, you may not find it even if it is present in that water body, right? Or is it simultaneously testing the water to determine that that's a hot spot? Because right now you're only testing the filet.

[00:10:19] **Speaker 2** We're only testing the fish. The USGS test the water, other agencies handle water, but we have within our GIS system, we have it mapped out so that our lakes are chosen that are highly suspected to be contaminated with PFOS.

[00:10:39] **Speaker 1** And is that a bigger threat long-term than...

[00:10:43] **Speaker 2** No. I mean, that's comparing apples and oranges. They both pose their own special threats. I mean, you still have PCBs in the background here. That's the OG forever chemical. Polychlorinated biphenyls, PCBs.

[00:11:01] **Speaker 1** In terms of, like, the work that you guys are doing here, is it always going to be, like what's the new thing to worry about, what's new?

[00:11:07] **Speaker 2** Uh, yeah, kind of, uh, if you want to be a little cynical about it, uh yeah, we got methyl mercury, now we have PFOS, soon it will be microplastics, after that it will 6 PPD coming out of your tires, I mean, this is a sense of monitoring, so we're not going to fix what's happening, but we were able to monitor what's happened, so say this is Ruth Lake, Ruth Lake right now may be clean, but I'll come back five years from now. My fish are showing numbers that weren't there, that weren't there in the previous years that we sampled. So now we know that there's activity going around that lake that is running off into there. And we need to alert whoever needs to know so that they can figure out how to control that point source pollution.

[00:11:56] **Speaker 1** So the reason for choosing Walleye to do the testing, is it just, it's an Apex Predator?

[00:12:02] **Speaker 2** Apex predator. Everyone wants it. It's like you said, it's a high commodity. It is a fish of the people. I mean, whenever I posted my picture, my selfie picture, like friends from Louisiana are like, that's a walleye. I was like, yeah, how'd you know? But yeah, they know, everyone knows it's walleye, so I mean you got musky too, people love musky, but nothing compares to the walleye up here. As far as the fishing, everyone wants walleye Yeah, everyone want's it.

[00:12:30] **Speaker 1** So that's why you would test that rather than something else.

[00:12:33] **Speaker 2** I mean we also test other fish. We test sturgeon, we test murk, muskie, we test whitefish out of Lake Superior, we test lake trout out of lake Superior. Right now we're focused on the inland lakes. We do the Lake Superior in the fall, we work on the Inland Lakes in the spring. So like we're in the summer now so we're wrapping up the project. All these samples are due Friday.

[00:12:52] **Speaker 1** But it's probably hard to imagine that people would ever not eat walleye, so you might as well know what it is.

[00:12:59] **Speaker 2** No one's going to stop. No one's gonna stop. So the best thing to do is educate. So if I can if I could convince people to put the big fish up on the wall or leave it in the water so it keeps responding the lakes and he's shaking his head. But I mean you saw that big one we got 230 grams nearly half a pound off of one filet. So I'll tell you one thing my uncle always copy. This isn't catching release. Yeah, it's not catching release, so the thing is we have to catch and educate. So, catch, educate. You can eat a contaminated fish, but you're going to want to eat a small piece of that filet and you're gonna want to do a literature search on anything that can attenuate the toxicity of methylmercury. And there are studies out there that have data to back that up. I believe the top dog in methylmercury studies right now is a guy called Michael could be even closer to retired, but if you go into PubMed, search Methylmercury, his name is almost on every single publication.

[00:14:06] **Speaker 1** Anything else that we should know what is the next step? So you guys are just taking the samples here, and then you bring me over to a lab, right?

[00:14:12] **Speaker 2** Right, so typically the next step, they would go in the freezer but since we're doing a mock trial transport, I have four samples, four lakes that we're going to do like a little mock trial run. I'm going to get everything prepped, settled. You already got those in the freezer? No, they're right there. So we had the PFOS. The PFOS ones that you saw were the ones wrapped in foil to help with any kind of cross-contamination. The mercury ones were the ones that went into the bag without any foil. We had the the otoliths for aging. We have two sets this time, typically there's only one set, our sister agency KBFC, they're training one of their own LTEs to how to age the fish. So we get the age, we get weight, we got the length, and we get tissue weight. That's going to be a, I believe that's a wet analysis on that tissue. And so all these things factor in together to help us know the proper mercury content of the tissue as well. And so the ODA list, one set will go here for our aging purposes here and that will go into the database and then the other set will be going to KBIC and there they're going to be doing a quality assurance or quality assessment. I got this, this is actually a secret, they're gonna find out after this airs, but I'm checking their numbers, seeing that they're aging right, and we're gonna compare the ages, so it's a lab check. What does KBIC stand for? I don't know. Q&A Bay Indian Community. Q& A Bay Indian community.

[00:15:42] **Speaker 1** Alright, can I get you to say and spell your name, give your title while we got you here?

[00:15:46] **Speaker 2** Do I do the doctor? All right, my name is Dr. Joshua Salley. Dr. Josh Salley, J-O-S-H-U-A-S A-L-L E-Y. I'm originally from Louisiana. I got a job here at GlyphWake beginning in March after what, my second midlife crisis.

[00:16:07] **Speaker 1** And what's your title here?

[00:16:09] **Speaker 2** My title here is the Environmental Toxicologist.

[00:16:11] **Speaker 1** All right, very cool.