

Forensic Ecology with Tiara Moore

Ologies Podcast

November 29, 2021

Oh hey, it's that spoon that doesn't match any of your other spoons and you have no idea how it got there, or if any of your spoons are somewhere in a stranger's drawer, Alie Ward. We are here the week after Thanksgiving, it's the start of Hanukkah, it's a month before New Year's, so many holidays in between, but this week... this week is a special one. It's Black In Marine Science Week, or BIMS Week. Do you like panels of experts talking about diving, and videos of fish, and pictures of cool sharks, and Real Talk Wednesdays? Yes, you do. So hop aboard; you're going to dig this.

So, this week we are talking with the CEO of Black In Marine Science about her work in Forensic Ecology. Oooh, Forensic Ecology. So, *forensis* is Latin for "court" or "in public," and ecology means the study of where we live. And when I put up the call for questions for this one, I knew you dear patrons would see Forensic Ecology and then maybe be puzzled and ask about crime scenes. So, I made sure to include this guest's long and prestigious bio, plus her Twitter and links to her published papers, just so you all could get a primer on her work, using environmental DNA analysis to figure out more about ecology. I still got a bunch of crime scene questions, including my favorite one from my friend Skella who asked about carnivores eating evidence. But everyone, let's just calm down, we're talking about a whole different situation, we're going to get to it.

Also Patrons, thank you for sending in your questions; you too can join for as little as a dollar a month and leave your questions about butts and DNA for ologists. And for zero dollars, you can also help an internet Dad out and just tell friends about the show. You can tweet, you can gram, you can tik, tok, rate, subscribe. Leave a review because you know I read them all so I can read one that you just left, such as this one from CookingInCollege who called this podcast hot, moist, brain food and said:

It's an all-you-can-eat smorgasbord of hot, moist, brain food. And yes, I am a brain food connoisseur.

Lick it up! Enjoy.

So, this ologist I have followed on Twitter for years, I loved Black In Marine Science last year and I've wanted to have her on to talk for so long. She got her undergrad degree in biology from Winthrop University, her Master's in biology with a concentration in environmental science from Hampton University, and a PhD in Biology from UCLA. And as we chatted a few weeks ago, she was working on her postdoc at the University of Washington. In her spare time, she founded A WOC Space, which is a consulting company focused on changing the cultural climate for women of color in the workplace as well as Black In Marine Science. Oh, and alongside Amanda Wise, she cohosts the podcast, *We Danglin'*, which is described as: two country Black girls discuss life, foolery, science, and social media.

And I'm sorry that I'm still talking but I just wanted to give you the background because I think you should know who you're about to fall in love with as we chat about finding your calling in the open sea, lab work, forest fungus, Missy Elliot, sedimentary soil science, straight-up racism, the state of allyship, marine science careers, and whether or not she may have found evidence for Bigfoot. All in this episode with Black In Marine Scientists CEO, biologist, environmental researcher, marine scientist, and forensic ecologist, Dr. Tiara Moore.

Alie: Well, hello Doc.

Tiara: *[laughs]* Hey girl, what's up?!

Alie: First thing, can you say your first and last name and your pronouns for me?

Tiara: Yes. I'm Dr. Tiara Moore, and I use she/her pronouns.

Alie: *Dr. Moore.* Do you have people call you Dr. Moore a lot?

Tiara: No.

Alie: No?!

Tiara: Only when they get disrespectful, *[Alie laughs]* and they pronounce my name wrong. So, my name is Tee-air-ah but a lot of people say Tee-ar-ah and I'll correct them, and then they'll still say Tee-ar-ah. So I'll be like, "Well, you know, you can just call me Dr. Moore, *[both laugh]* so we can just cut all of that out."

Alie: That's the best. You're like, "Is that easier to pronounce for you? Dr. Moore?" *[both laugh]* That's amazing.

So, can you tell me a little bit about what you studied when you were going through undergrad and graduate? If you kind of got to take any turns along the way, or what led you to doing the career that you do now?

Tiara: Oh wow, okay. That's a great question. So, undergrad. I actually went to undergrad, pre-med. I thought I wanted to be a pediatrician, but then I realized, sorry y'all, but I didn't like kids like that, so it wasn't going to work out. *[both laugh]* No, this is probably not going to work out for me. *["I'll pass."]* But I was already in the biology major, taking all these courses, so I'm like, aw dang, I don't want to have wasted this time. So, I started taking other courses in biology.

And there was this one class called Tropical Ecology that I signed up for, and I'll be honest, I only signed up for it because they were going to Costa Rica for spring break, so I was like, "Oh free trip, yes!" *[laughs]*

Alie: That's amazing.

Tiara: But then I got there, and we were, like, on a boat collecting water samples, and we were doing these experiments, and senior scientists were there instructing us, and I'm like, "Hey, are y'all getting paid? Is this a job? Let me know." And that's how I really found out about marine science. So, I came back from that experience completely changed, wanting to go into this path.

So yeah, I looked for graduate schools that had marine science programs because I wanted to do a master's program. And I remember writing in my personal statement, like, *[nervously]* "Hey, I took this one marine science class but please accept me, this is what I want to do. I'm a good student!" So yeah, they accepted me. I went to Hampton University which is an HBCU or a Historically Black College and University, and it was a great experience.

Aside: And side note, Hampton University is in Hampton, Virginia. And not only does it boast alumni including Booker T. Washington and former Surgeon General Sylvia Trent-Adams, Dr. Tiara Moore, and Wanda Sykes, but you may have just seen their marching band in the Thanksgiving Day parade. So, hail, hail to the mighty Hampton pirates.

Tiara: And then I did research there in the Chesapeake Bay in water quality, trying to understand how humans impact water quality there. They have these huge... a lot of pollution of nutrients in their water bodies there, and so that can lead to these algal blooms or phytoplankton blooms, and then those sit on top of the water and consume all the oxygen that's there, and that can be harmful for fish. So, you can imagine if you have these organisms on the top using up all the oxygen, then the organisms below won't have any oxygen for themselves.

So yeah, that was my master's research, and then I moved across the country to California and did research in the estuaries there in southern California, so where the saltwater meets the freshwater. And again, was trying to understand human impacts in these areas with nutrient pollution and how that changed the water quality there.

Aside: So, to get into the microscopic details of forensic ecology, Dr. Moore has a long list of published papers, and talks, and articles like, "A Biodiversity Composition Map of California Derived from Environmental DNA Metabarcoding and Earth Observation." Or, the *Journal of Water Resources and Ocean Science* paper titled, "Sedimentary Oxygen Demand and Orthophosphate Release: Sustaining Eutrophication in a Tributary of the Chesapeake Bay." So, a eutrophication, it sounds kind of like a good thing, but it actually means extra nutrients in water sources that can wonkify the ecology. So, that paper was all about the extra phosphorus and nitrogen leading to an overgrowth of phytoplankton, which then die off, settle to the bottom, and end up releasing orthophosphate, which is something used to mineralize the inside of lead pipes to protect from corrosion.

Oh, and her PhD thesis was all about algal blooms in estuaries. And an estuary is just like a beautiful brackish armpit where freshwater meets the ocean. So, as a marine scientist, Dr. Moore studied all kinds of watery badness, goodness.

Tiara: And so, I was actually giving a talk about that research I had done, and someone came up to me and was like, "Oh, this is really interesting, do you think you could do a similar project of trying to understand biodiversity or the species presence in these ecosystems in a forest?" So, I was thinking about it, I was like, "Oh yeah sure, sounds cool." I was thinking about the techniques. And then they asked me the next question like, "Well, could you do it?" [chuckles] And I was like, "What? [laughs] I'm a marine scientist, what do you mean? I don't work in the forest." Well clearly, long story short because that's what I'm doing now, I ended up taking on that job, that position and that is my current project.

Alie: Now, where are you based out, where you do forest work?

Tiara: [laughs] So, my base is in Seattle, Washington but the forest is in, I guess, Naselle or Long Beach, Washington... so about three hours or so from Seattle.

Alie: Now, can you go back a little bit and tell me, when you are talking about nutrient pollution, is that when a certain species gets overfed in waters? What causes that?

Tiara: Yes, so nutrient pollution predominantly comes from human impact. So, things like deforestation, removing trees out of the forest, that's bringing up nutrients out of the sediment. But then also agricultural run-off, so we have a huge, huge agricultural practice because we have so many people we have to feed. They put a lot of fertilizers on crops that are filled with nutrients, so as soon as it rains, those nutrients are washed into the waterways.

So basically, nutrients feed these organisms that I mentioned, the phytoplankton or these macroalgae. So, imagine you're at a buffet right, you have a whole lot of food to eat [Alie

laughs] so you just keep eating, you just keep eating, and you're eating, and you're growing and you're growing, and now all of a sudden, you're taking up the whole water column. It's like, "Oh snap! What happened?!"

So, because of our practices here, what we're doing, that stuff gets into the ocean, and they do what you expect anything to do that's been given a whole bunch of food, they eat it. And then that causes the adverse impacts to the other organisms in the ocean or in that ecosystem.

Alie: Has that been going on for different reasons before humans started becoming industrialized? Does that just happen in nature? Or is that something that really started when we started changing the ecosystem so much?

Tiara: Oh yes, it's us. [*laughs*] It's us.

Alie: It's us, it's us.

Tiara: Come on now. So, these organisms are definitely supposed to be inland, like, phytoplankton are there, photosynthesis is real, nutrients and sunlight, that's what they need. So, you imagine if you give them a whole bunch of nutrients, they're going to continue to do the job that they are there to do. So, it's supposed to be this regulated amount that is in these ecosystems but we're overfeeding, over-inputting into these areas. So, it definitely started with us and us just doing a lot.

There's like, different policies and things of waste dumping, they started with that; the total maximum daily load that people can put into the water. But it's not as regulated for things like agriculture, because again, how could you regulate water run-off? But you could if we said, "Hey, we shouldn't be putting all these fertilizers on these crops to begin with."

Alie: And what kind of tools does a forensic ecologist which, by the way... it's a pretty cool ology. [*laughs*] That's pretty rad. What kind of tools do you need? Are you looking at bay water or pond water through microscopes? Is it all DNA stuff? What's happening?

Tiara: Yes, so it's all DNA stuff. This is so funny, that title. Actually, I think it was an article, a news reporter interviewing me about this stuff and it's like, "Oh, this is exactly what this is." And I'd like to make the relationship between every crime show that you watch, there's a criminal who will do something, they'll touch the doorknob as they're walking out and then the detectives come in and are like, "Oh, here's a fingerprint! We have their DNA, we now know who is there." So, that's basically what I'm doing in the ecosystem.

You can do this in a variety of different samples, it really just depends on what you're interested in. You can use water, you can use sediment, soil, air. So, there's a lot of different studies that are utilizing these different environmental samples. And this is because, as we're moving through the environment, as you know, humans are sloughing around, organisms, species, anything... as we're moving around, we're shedding genetic information; skin, hair, feces, mucus, [*"Yum."*] pollen, leaves; all of that has genetic information. And as soon as it is dropped into an environmental sample like water or soil, we can now collect that sample, extract the DNA, and tell you information about those species, the biodiversity in that ecosystem.

Alie: Do you ever find DNA that you're like, "What is *this* doing here?!"

Tiara: [*laughs*] So, yes. Yes, but... here's the thing and I want to... [*laughs*] Yes, *but*. So, the beauty of environmental DNA is that, imagine like... biodiversity studies are trying to understand species, you would need someone who understood all the species. And that's generally

what you do, you have a taxonomist who knows all these species, or they go out and do surveys, or they'll put out camera traps. But the beauty of this eDNA is that you can collect the soil or collect the water sample and then extract the DNA, do a series of lab work steps, and then upload the data to a database, and then you have access to the information. Like, now here's a whole species list. And me not being a taxonomist or knowing all these species by name, I now see, "Oh wow, this is all that's there."

Aside: I know what you're thinking. You're wondering if eDNA is some kind of new electron scanning DNA machine. But I'm here just to bust in a whisper, nope. It just means environmental DNA. And technically it's been around for as long as the *Robocop* movie franchise, 1987, when marine geologists started looking at bacterial colonies in ocean sediments. But of course, DNA sequencing has gotten cheaper, and faster, and much more widespread in the last 35 years. Aren't you relieved that it's not something more complicated? Kind of like the time I was at a fancy restaurant and saw *miel* on the menu, just to learn that it was French for honey... like, what? Okay. So, environmental DNA is everywhere and forensic ecologists like Dr. Moore can learn a lot about an environment based on what's there and in what numbers.

Tiara: There are some things that I'm like, "Oh wow, what is this doing there?" But then I have to then go and do more research to find out what the organism is and where it does belong. So, I'm getting a huge data set but I'm not necessarily like the taxonomist who assigned them.

Alie: When you're starting a project like that, do you usually have an overarching question you have to answer, like how much of a certain thing is in the soil? How do you even approach something? Because there would be so much DNA in such a wide field, how do you start?!

Tiara: Exactly, you start at the beginning. *[both laugh]* But honestly, it does depend on your question. And you know, science, well we hope, science is question-based; you have a question you want to figure it out. So, for me specifically, and I can talk a little bit about other eDNA studies, but for my project it's more presence/absence. Can we understand what's there in this ecosystem, can we understand what's going on in this environment? So really, we're almost saying, "Hey, what can we find?" We're not asking a particular question.

But for some studies, they are looking for a particular organism or species, trying to see if it's there in that ecosystem and then you would handle that by your lab work. So, I kind of just lumped the series of lab steps into one thing, but that's where you really go into depth with your actual question. So, if I'm saying "Hey, I just want to know presence/absence," okay, then that lets me know in my lab, when I tag the DNA... So, you start with soil, but then you extract the DNA, so it turns into a liquid, and then you tag it with these primers or coding areas that says, "Hey, we're looking for these different organisms."

And so, you can use generic or universal primers that say, "Hey, we're looking for everything." Or you can say, "Hey, I want to know about this exact fish, this is the only fish I care about. I want to know." So, you can make a primer that targets that particular fish, so you could tag your DNA, your samples with that. So, it really does depend on what your question is, what your tools are that you then use in the lab.

Aside: So, those primers, and you can call them oligonucleotides for short, are single strands of DNA, or RNA, maybe a dozen or two nucleotides long. And figuring out which genes to use in those primers can be tricky. It's better to have C and G base pairs on the

ends of the snippet because their bonds are stronger, but you have to make sure that it doesn't bind to itself. You don't get to just ask a machine like, "Hey, what's in there?" Machines are great, but your brain is one of the machines, and it has to figure out exactly what to tell the other machines to look for, via primers.

Alie: Has it changed a lot since when you started your PhD until now? Like, has technology made it a lot easier to do the work?

Tiara: Oh yes, I would definitely say so. I mean, they have all types of things now. So, if you're in a wet lab, there's a lot of pipetting, or moving liquids from one little vial to the next. And so usually, you would be able to do one at a time. And then, I would say, when I was in, maybe... master's, they had one multi-channel pipette so you could do eight samples at a time. Now, they have robots! *[laughs]* You don't even have to touch a pipette, and you could just set it up all fancy and get all your samples. My lab didn't have that personally, but I'm just saying, they have it, it's available.

And then they also have really good kits that are really easy to follow, that gets the sample that you collect to easily be able to extract the DNA from it. As you can imagine, if you're collecting soil or water, how do you get to that DNA? So, there's a series of steps where you have to wash the samples really good, release that DNA, and then capture it. So, there's a kit that can literally walk you through all that steps now in like, two hours. And that's pretty cool.

Aside: I have heard of these easy DNA kits, literally called EZ-DNA and they explain their effortless product as something that, "Consolidates DNA denaturation and bisulfate conversion processes into one step, leading to a much faster bisulfite conversion." And that, "recovered bisulfite-converted DNA is ideal for PCR amplification for downstream analyses, including endonuclease digestion, sequencing, microarrays, et cetera." I mean, clearly, I downloaded the eight-page PDF of the kit's instructions to see exactly how much I could digest, and it had helpful nuggets such as, "Soft tissue, such as brain, does not require the use of a homogenizer: a pipette can be used to homogenize."

So, those are some of the very literal granular details of forensic ecology. But let's look at the bigger picture, shall we?

Alie: When it comes to things that are environmental and you're seeing climate summits and headlines, is there something that, as a forensic ecologist, you're like, "Why aren't we looking at this?!" Or, "This is such a big deal!"?

Tiara: Oh, my goodness, yes. I would say... oh man. My favorite TED Talk is talking about a climate change solution right up under our feet.

[clip from TED Talk: A climate change solution that's right under our feet]

"It's soil. See, a 6-foot or so of soil, loose soil material that covers the Earth's surface, represents the difference between life and lifelessness in the Earth's system."

Aside: So, that talk with UC Merced biogeochemist, Dr. Asmeret Asefaw Berhe, will be linked on my site in the show notes.

Tiara: And she's talking about in this whole TED Talk about dirt and soil and it being really important because there's a whole microbiome, a whole community of organisms that is keeping the soil healthy, the soil intact. What we know is that there's so much carbon storage in the soil. And so, when you think about climate change, we know largely it's because of excess carbon products like carbon dioxide or methane that's in the

atmosphere. So, you hear everybody talking about, “Plant trees! Plant trees!” so that would help to take up that carbon. And okay, that’s fine, the trees do take up that carbon that’s causing climate change, but what are these trees growing in? The soil! And so, healthy soil will lead to healthy conditions for trees, and then also will be able to store more carbon as well.

Alie: How’s your gardening game? Are you really good at gardening or are you like, “I’m too busy to garden?”

Tiara: [*laughs*] Did you just ask me if I had a hobby? [*both laugh*]

Alie: Touché.

Tiara: [*still laughing*] I can’t even stop laughing, it’s just so funny.

Alie: I know, not even time for crocheting, yeah.

Tiara: Yeah.

Alie: Do friends come to you with like, “What did I do wrong with this houseplant?” And you’re like, “I can’t... I can’t help you.”

Tiara: They all know better. [*both laugh*] They all know better. Because my friends actually more see me as a lab scientist, they don’t see my photos of me out in the field but they’re like, “Oh, Tiara is in the lab.” They really think I’m like Bill Nye, that’s what they think. [*both laugh*] So, there you go.

Alie: And now, you identify as a marine scientist even though you might be working on soil and forests right now. Would you say your heart is in marine science? How do you feel about that?

Tiara: Oh, my heart, my soul, yes. It is definitely in marine science. I mean, I still have that same excitement from that trip in Costa Rica. And then I’ve also had the opportunity to travel, and scuba dive, and do some really awesome projects. I think this was an intriguing opportunity for me, but I know my next position and everything I’m going to do will be back in marine science.

Alie: Oh, and I want to know a little bit about Black In Marine Science. That’s coming up on the 28th, right?

Tiara: Oh yes! So, Black In Marine Science Week 2! This is our second week of outreach. And so yeah, I’m very excited about that. It’s going to be a whole week, November 28th to December 4th, [*“That’s now!”*] and we’re going to have different panels and workshops, keynote speakers, all talking about different experiences being Black in marine science, talking about our research, talking about diving activities, just talking about so many different things. And the whole goal is to really, first of all, dispel the myth that Black marine scientists don’t exist. You just don’t even know how many times I’ve introduced myself as a marine scientist and people say, “Oh, you can swim?” I’m like, “Really? This is what we’re doing?”

Alie: Oh my god. Oh my god.

Tiara: So yeah, it’s a little bit rough.

Aside: And that, side note, is more than just offhand blatant racism, it’s also something that has deep roots in Jim Crow era American segregation, when people of color were denied access to swimming pools. Even in 1969, Mr. Rogers wanted to educate people

about this and made an episode soaking his feet in a small kiddie pool with actor François Clemmons, who played the role of Officer Clemmons on the show, just to call attention to the fact that this was still happening.

In the 2021 book, *The Sum of Us: What Racism Costs Everyone and How We Can Prosper Together*, by author and Yale Law graduate, Heather McGhee, she details that into the 1970s:

Draining public swimming pools to avoid integration received the official blessing of the US Supreme Court in 1971. The city council in Jackson, Mississippi had responded to desegregation demands by closing four public pools and leasing the fifth to the YMCA, which operated it for whites only. Black citizens sued, but the Supreme Court, in Palmer vs Thompson held that a city could choose not to provide a public facility rather than maintain an integrated one.

So, the result of segregation and racism has had generational effects and Black people in America suffer higher rates of drowning, are excluded from some career paths, and experience a lot of offhand and targeted prejudice that white folks do not.

Tiara: I'm still passionate. I didn't want that to make me want to leave. So, Black In Marine Science is really the manifestation of us saying, "Hey, we're here, we're doing awesome research, and we want to get more Black folks in the field." So yeah, it'll be a whole week of outreach.

Alie: And you founded that, which is one reason why you don't have any room for hobbies.

Tiara: [laughs] Yes, I'm the founder and CEO of Black In Marine Science.

Alie: How was that process? When you were deciding: I want to do this, I want more visibility, I want people who are looking for more mentors and colleagues to come together too... When did you decide, "Okay, I'm just going to go for this"?

Tiara: Okay, are we doing the real raw or are we doing the--?

Alie: Yes! Yes.

Tiara: [laughs] Okay. I mean, like I mentioned, me as a Black woman marine scientist, especially at the PhD level, is just not common. So, I was working in a space where I was the only Black person in the lab, was the only Black person with a PhD that these folks had ever worked with. So, it was, like, this weird experience and there was just a lot of racially charged experiences that I dealt with, and it really had me thinking about walking away from the whole situation. Just like, "Hey, I can make TikTok videos, I could work at Chick-fil-A. I can do something different because this is not what I signed up for."

I think I had experienced stuff going through school, but I'm like, "Oh it's because I'm a student," or "I haven't earned my place at this table yet." But once I, you know, earned, or how they say, it was like, "Oh wow, I'm still getting treated like I don't belong here? Oh snap, wow, this is disappointing."

So yeah, I had to make a decision of, I know I'm not the only Black marine scientist because I've met folks here or there, but there has to be more of us. And so, yeah, Black In Marine Science week came around where 2020 was happening, where there was so much racial discourse, and so many things going on, and there was other science organizations that were having these weeks of outreach. It actually started with Black Birders Week.

Aside: And since they started that movement, there has been a rise of so many fields like Black in Neuro, Black in Chem, Black in Natural History Museums, and of course, Black in Marine Science.

Tiara: So yeah, I was there, and I was like, “Wow, where are the other Black marine scientists?” And I just tweeted that out and there was such a great response. Like, “Oh wow, what? I’ve been here by myself, I’ve been here by myself. Let’s meet up.” And so, we created this week, and it went really well, and we raised a good amount of money, and that’s when I really saw the needs of the community. There were all these folks in these labs, in these workplaces by themselves, and now we had found each other.

And so, that’s when I decided to turn Black In Marine Science into an actual nonprofit that we can build and raise funds to actually support and do outreach and really enrich the field. So, it’s definitely... it was a risk for sure and it’s been a lot of work, but it’s been sooo, so impactful and it’s just been worth every second, every hour that I’ve spent on it for sure.

Alie: I’ve read the hashtags too with #BlackInTheIvory and just how many people who are Black in academia are just pushed to want to leave, that it’s just not worth their sanity to stay in an environment where they might feel undermined or there are aggressions or exclusions. Do you have any advice for anyone who might feel alone in that or anything that has helped you stick it out or has helped the environment at all?

Tiara: Oh yes. I would say first of all, is that you aren’t alone. If you can hear my voice, know that I’ve definitely experienced this with you. I think that it can feel so isolating when you’re in the moment that it’s gut-wrenching, it’s heartbreaking. You’re like, “Wow, I’ve done all this work, I’ve made it to these spaces.”

I think what can be equally as disappointing for a lot of people of color when they get in these experiences is that they’re probably part of some diversity initiative or recruitment effort that specifically brought them to this place, and now they’re being treated as if they weren’t specifically brought to this place. So, I think that’s what makes it even worse because you’re like, “Oh wow, this is going to be great.” And then you get there and you’re like, “Oh snap, did you know you hired me? Did you tell the rest of the group?”

I think for me, I was surprised because I’m like, “There’s no way this is happening to other people,” but then I started talking to other people and I was like, “Ohhh, ohh...” I think it’s because other people weren’t talking about it, that’s why I was blindsided. So now, I’m screaming from the roofs, “Hey, you need to know what’s gonna be up.” And so, you can have that community. I think if I had known going in, I would have made sure that I had a better support system around me and maybe not even accepted the position at all, to be honest.

So, I think it’s being true to yourself and understanding what the conditions are that you’re going in and asking a lot of questions. I know, especially as a Black woman, we’re like, “We’re not going to ask any questions, we don’t want to be seen as aggressive, we don’t want to cause any problems, so we’ll just chill.” But no, no. You have to ask questions and advocate for yourself, and I think that’s been the most impactful change I’ve seen; me just saying, “Hey, that was racism. That was a microaggression,” and just calling it out. But that can be time-consuming. I’m hoping that if I’m speaking up then maybe another person won’t have to, that they’ll change their behavior.

Alie: Have you seen any changes with any initiatives in the past year or so? Has any allyship actually been paying off? Or have you felt like it’s a lot of talk?

Tiara: [exasperated] Oh...

Alie: Sorry, you don't have to answer that if you don't want to.

Tiara: No, I think there has been some really good allies that have stepped up for sure. But for the most part, there's been a lot of performances, there have been a lot of folks who put up diversity statements and didn't do anything.

But then there's been folks who said they were going to do different... And I can actually call out, because I feel like I should, our funder. Black In Marine Science received a grant of support from the David and Lucile Packard Foundation and they really made a statement of wanting to diversify their funders. Whereas other organizations, they'll say, "We might amplify your content," or "Can you come speak on a panel for us?" But they're not truly giving the support that's needed. And then even inside their own organizations, a lot of folks of color don't feel like many things have changed. I would say, wholly, it doesn't seem like a lot. But also, I think it's just slow. Maybe I'll say that.

I think for me, since I was able to build Black In Marine Science to what it is now in less than a year, I'm confused that people are just now people are getting diversity committees established in that same time. But for them, that's still movement, that's growth. So, it's like, do you discount it? They got a committee now so, okay! [laughs] So, I think that's where we are now, it's a lot of baby steps, if that makes sense.

Aside: Which is very generous of her to say. There's a lot of work, folks. Nobody fixed racism in 2020. And something like Black In Marine Science is wonderful because you can follow so many people you might not have known before and learn great science and also the realities of being historically excluded, if that hasn't been your experience.

And if you're in a historically excluded minority, you can find your hashtags from #AsianAndPacificIslandersInEcology to #LatinxInSTEM, #NativeInSTEM, #LGBTQInSTEM and #DisabledInSTEM folks. There's even a #NeurodivergentInSTEM and #ADHDInSTEM. And Dr. Moore is really open about how ADHD has factored into her life too.

So, everyone, your people are out there, and they are down to shit-talk about the same things that you have been through. Dr. Moore says she feels so much better being connected to these groups. But...

Tiara: But I think we all still would rather, you know, want that support at our actual jobs. Because this is me having a job and then having to run another organization to be able to get some comfort, when it shouldn't necessarily be like that.

Alie: Yeah, of course not. Any panels in particular that you're really excited about? Is there any one that you got on board this year that you're really stoked about?

Tiara: So, I'm excited to announce we'll have a #BIMSreads event every day so we're going to be highlighting Black In Marine Science authors. And so, different authors who are Black marine scientists who have written a book. So, of course I'm excited to say that we have Dr. Ayana Elizabeth Johnson coming to read from *All We Can Save*. But we also have some other awesome authors as well.

A really awesome keynote we have is Queen Quet, and she is over the Gullah-Geechee Nation in South Carolina, so I'm very excited to hear her talk about that community and her outreach in that community.

And then we're ending the week, we have a Diving While Black panel, and so that's going to be talking about all of our experiences as scuba divers. So yeah, we have a lot of stuff. Oh, and on Thursday is all dedicated, it's called Youth Thursday so it's all about youth outreach.

Alie: Yeah, I loved it last year and I always love the first day, like Sunday you've got roll call.

Tiara: Yesss!

Alie: If you want to get the best timeline full of awesome marine science facts, show up to roll call and just follow, follow, follow, follow, follow. *[laughs]* You know what I mean?

Tiara: Yes, the BIMS roll call is very... That was, honestly, I was crying probably every 30 minutes last year, I was like, "Where are these people coming from? Oh my gosh, I'm so happy, I'm so happy!" So yes, the BIMS roll call. And we're also doing another hashtag on that day, it's going to be #BlackOnTheBeach and that's really trying to get every Black person involved in this roll call because we all have a connection to marine science and specifically to the ocean. Everybody loves ocean selfies so we're trying to have that hashtag as well to truly include our whole community.

Aside: That hashtag is #BlackOnTheBeach, and all week there are virtual events and talks. There's BIMS Dives Into Ocean Justice, How to Respond to Trauma, trap yoga, Marine Science Career Panel, Diving While Black Panel. Hashtags like #BIMSweek, and #BlackInMarineScience, and #BIMSrollCall, and #CommotionInTheOcean, and #GivingTuesday, and #IAmNotMyHair. And the capper is the December 4th BIMS Ball, which is a virtual black-tie event. So, all of those events will be right at a link in the show notes because I do not expect you to write all that down.

Alie: Augh, it's so great. I imagine that you must start planning next year like the day after the week is over. *[laughs]*

Tiara: *[laughs]* Yo, it's so true. I mean, it's turned into a huge thing but no, you're giving us way too much credit, we just started a couple months ago... just a couple months ago.

Alie: I have questions from listeners. Can I ask you some?

Tiara: Oh snap. Let's do it, let's do it.

Alie: Okay!

Aside: And before we do, of course, let's toss some money at a worthy cause and this week of course we'll be sending some to Black In Marine Science, but also Dr. Moore asked if we could do two, and of course. So, we're also sending some to Black Women in Ecology founded by Dr. Nikki Traylor-Knowles, who was also tired of hearing that Black women don't exist in the marine sciences. And BWEEMS has over 200 members from undergrads to retired professors, and it was built to support innovative science, develop community, promote mentorship, and professional growth of Black women in ecology, evolution, and marine science. So, more info is up at BWEEMS.org and those donations were made possible by sponsors of the show.

[Ad Break]

All right, back to the topic at hand, Forensic Ecology.

Alie: Okay, Jackie wanted to know: How do you determine how or where to sample an environment for eDNA? I imagine in marine environments, everything is pretty evenly

mixed for you, but how many samples do you need to get from the soil to get a good picture of what's going on? How many samples is enough samples?

Tiara: There's never enough samples!

Alie: I figured.

Tiara: *[laughs]* So, you just have to... You just have to guess. And you just have to... I mean, you make a scientific decision. You figure out your area that you're going to, you look around and say, "What types of samples do we need?" Statistically, it's three to five for each area that you're collecting from. But if you can imagine, if you're doing a whole forest, we would need a whole lot more samples. So, I think in total, we collected about 400 and some samples.

Alie: Do you have to store them on ice at all or is it pretty stable?

Tiara: Yeah, so it depends on your sample. You can use stabilizing solution, but you do want to get them back to the lab as quickly as possible to start the DNA extraction process.

Alie: Are you just putting them in vials and test tubes while you're out in the field?

Tiara: Yes. Yes, so I have this really super high technique method of using a Slurpee straw *[both laugh]* that you can get from Sonic or, like, 7-Eleven. Because if you think about a Slurpee straw, it has a perfect little scoop on the end.

Alie: Yes! Nice.

Tiara: *[laughs]* I have thought about this because you're using plastic, but it's sterile because I can just open it up, and then just scoop it, and then just throw it out and use another Slurpee straw for each sample, and not have to do any, pulling out alcohol, disinfecting, and all this and that.

Alie: And then also, on the way to the field site, you get to go to Sonic or 7-Eleven. You have to.

Tiara: Come on now! We order them, we order 'em, we order 'em. *[laughs]* I couldn't just go take 500 straws from Sonic. *[both laugh]*

Alie: You're like, "What? I got fries too, come on. I can't take a huge handful of them?" on your way to the forest. *[laughs]*

Tiara: "These belong to me now."

Alie: I literally thought that you went and picked some up on the way. *[both laugh]* Didn't even occur to me that you can order them.

Tiara: I mean, you know you can order anything now, you can order anything these days.

Alie: That's true.

Aside: And because I'm sure there are a few of you out there wondering... Yes, doing science and keeping down contamination in a lab does have a plastic price tag. And a 2014 study found that science labs generate 5.5 million tons of plastic waste every year. But when you're actively trying to save the planet, and you need it as lab equipment, and you dispose of it properly, you get a straw pass.

Alie: Elliot Cooper had a question about your preferences. Elliot wants to know: How much of your work is devoted to land versus water habitats? Is one more appealing to you than the other? And I feel like we might know the answer.

Tiara: Yeah, it's the water for me. *[laughs]* It's the water for me. So, I mean, because I'm working on this project, all of my efforts are definitely focused on that land project, but my heart is focused on the water project. But I'm actually in the midst of finishing this up.

Aside: So yes, she is doing her terrestrial postdoc, but literally just a few hours ago, Dr. Moore announced that she has a new position as Black in Marine Science program lead at the Nature Conservancy. So, so many party horn emojis about that.

Alie: Kelly Shaver wants to know: Do trees and other plants really have unique DNA that can be identified or is that just something made up for TV?

Tiara: *[giggles]* They do!

Alie: Really?

Tiara: They do! Yes, there is a diversity of different trees and plants that you can use. Like a tree primer, you can use eDNA to find that out. So, yeah you could be able to identify different species using this technique.

Alie: That's so good to know. I thought this was a great question. Dirty Dan, maybe this guy's really into soil too, Dirty Dan, wants to know: Is there a noticeably different fungal footprint in the soil of old-growth forests?

Tiara: Yo, Dirty Dan, that's the whole purpose of my project right now. *[laughs]* *[DJ airhorn]* Dirty Dan! So, that's what I would love to see. I'm literally in the middle of doing the analysis. So, we did all the lab work then COVID shut me down and I got a little bit behind, but that is exactly the type of information that we would like to see in the forest and that's why WE have the different range of tree ages that we collected from. So, we actually have samples that I collected that were in the old growth but then also in the clearcut, meaning there were completely no trees, but then also different ages of trees in between when the forest was clearcut and where it got restored. So, I think understanding the signature of the fungal biodiversity in the old growth will really help us to understand our restoration efforts. So yeah, that's really a goal of the project Dirty Dan, so thanks for calling that out.

Alie: Nice! Lina Zikas wants to know: When looking for DNA to capture, is there anything that can mess it up real bad? Like a chemical that can get in there or a fungus? But in this case, you want to know about the fungus. Any bad contaminants?

Tiara: I mean... So, DNA does degrade so I'm sure there probably could be something that could get into it that would cause problems. But that's the beauty of this environmental DNA method is that you can have a really small fragment of DNA and potentially still be able to identify it. So, even if it is partially degraded or something has happened, it could potentially still be picked up.

Aside: So remember, as organisms move through water and soil, they're shedding little skin flakes, and mucus, and poop; whatever, it's casual. And then a cool scientist like Dr. Moore collects the samples, takes them back to the wet lab, AKA the lab with all the jars and stuff, and extracts the DNA, figures out a primer sequence of a dozen or so RNA nucleotides called oligonucleotides, amplifies that code, and then can identify who or what has been where. And those observations and IDs, even if they came from a teeny, teeny, tiny thread of frog spit, are starting to be called OTUs, operational taxonomic units. So, forensic ecology, it's like CSI but instead of fictional sufferings it's just a particle of a butterfly wing, or a microscopic fungal cell wall, or a shed larval skin. Somehow, it's both creepier and cooler.

Alie: We had a question from Garden Specialist, who apparently *does* have time to garden, and wants to know, regarding the 2021 paper, “Flip it and reverse it: Reasonable changes in designated controls can flip synergisms to antagonisms,” would love to know more about coming up with that title. How did such genius emerge?

Tiara: [*laughs*] That is hilarious. You really did send these folks my Research Gate and they really looked! [*laughs*]

Alie: Of course I did! Yes!

Tiara: That is so funny. So, that whole paper is talking about like you said, flipping the control of a project, like you know, you can have like... Say you’re doing an experiment, so I put nutrients in one thing, and then something that doesn’t have nutrients is the control. So, we were trying to think about, what if that wasn’t the control? Who states the control, basically. So, if you flip these interactions around, how will that change the paper? So, the lead author on that paper, Caitlyn Fong, actually came up with the title. And so, it’s definitely an ode to Missy Elliot for sure, [*laughs*] flip it and reverse it.

Alie: I hope she knows. [*“Flip it and Reverse It” plays*] Do you think anyone’s told Missy Elliot that there’s a paper that cites her work?

Tiara: Oh man, I don’t think so. But that would be awesome if you did.

Alie: I know!

Aside: So yes, Missy Elliot, two items on the agenda. Please talk to me about Iconology, your album. And also, you need to know that Dr. Moore was an author on Dr. Caitlyn Fong’s paper, once again titled, “Flip it and reverse it: Reasonable changes in designated controls can flip synergisms to antagonisms.”

Alie: If I get her on, I’ll let her know about this paper.

Tiara: You have to... you have to! I could just go ahead and die then. [*laughs*] It’s all over.

Alie: I thought Alanda Kohl had a good question: When inspecting a site, what’s the biggest red flag and signal of historical contamination?

Tiara: That’s an interesting question because okay... That’s when you really have to think about depth in the soil if you’re thinking about a forest, because I’m collecting, like, surface soil, the top layer. I so that’s anything that’s been, you know, the most recent. But if you start going deeper into the soil, you would need to pair that with carbon dating and things like that so you could understand the timescale. So, that would be a whole different set of folks working on that type of project. But I think people actually are trying to understand if you could see generational changes in biodiversity.

Alie: Yeah, I imagine it’s just like a big, parfait full of dead things and mystery.

Tiara: Yes, it is. It is.

Alie: We had three people, three patrons ask questions, Derrick Allen, Shaelyn Clark, and Euan Munro... [*“His first name is the anglicization of the Scottish Gaelic name Eòghann. Because yes, you do want to say ‘You-wan.’ Do not say ‘E-wan’, but rather ‘You-wan’. You-wan, You-wan, You-wan, You-wan, You-wan.”*] ... And Euan Munro [*“You-wan”*] want to know if you have ever found any environmental DNA that would suggest cryptids, like in Derrick Allen’s words: To suggest Bigfoot or other cryptids/elusive organisms? Shaelyn wants to know: Find anything spooky? And spooky DNA? Anything mysterious? Euan wants to know: Anything where you’re just like, [*whispers*] “What is it?”

Tiara: *[laughs]* So, this is funny because I think there was one time, oh man... what is it? Bigfoot? Does he have something else...?

Alie: Like a yeti and Bigfoot, I think are the same thing...?

Tiara: Well, either way... Okay, so when you get the data, you have kingdom, class, but genus and species. So, humans are *Homo sapiens*, right? If that's the sample you get, the taxonomy you would get is *Homo sapiens*. But for some reason it didn't go all the way to species level, it stopped at genus, and it just said *Homo*. And so, *Homo*, right, would be like Bigfoot. *[Alie gasps, Tiara laughs]* But there's no way. There's no way! *[laughs]* There's no way. So, I just, you know, charged it as, 'it just didn't go all the way'. That might have been an example of, like, a degraded sample so we couldn't process it all the way. But that was interesting because everyone on the team was like, "Tiara found Bigfoot." *[both laugh]* And I'm like, "Stop saying this, stop saying this."

Alie: I love that that's the rumor in the lab that day, that you just casually uncovered Bigfoot DNA. *[both laugh]*

Oh, last questions I always have to ask: what is the hardest part about environmental DNA or marine science? I imagine you don't get seasick, if you're a marine scientist, very often?

Tiara: No, I don't get seasick. I mean for me, and I'll just say, physically, and I'll be honest, for this last project that I was working on in the forest, it was a challenge just hiking in this forest. It was rough. Ya girl was struggling! *[laughs]* So, really thinking about where you have to collect samples from. Especially because I was used to either getting off a boat or pedaling my way into an estuary off of just sliding down some sediment, so that was a bit rough.

Alie: And you're carrying all your gear too, probably. Right?

Tiara: Exactly! Exactly.

Alie: And that is your work. You can't just, like, trip on a root, and spill everything, and have that be a casual mistake, you know?

Tiara: Right. So, I'll be honest, I went out collecting the first time and then I had to bow out gracefully and say, "Hey, *[laughs]* somebody else gotta get the rest of these because I can't do it."

Alie: Yeah, I just think it's so interesting to know that people who are figuring out how the world is affected, especially by industry and the way that we're changing the environment, are doing it with sometimes these tiny scoops of soil; can tell these huge stories, you know?

Tiara: Yes.

Alie: I think that's so cool. You're a detective!

Tiara: I'm a detective! It's so cool. Dirt detective, soil detective, whatever you want to call me. It's so cool.

Alie: What about your favorite thing about being a scientist?

Tiara: Oh man. I mean, I get to do this job. Honestly, sometimes I feel like I'm getting away with murder. Specifically, when I'm doing my marine science stuff. When I was traveling the country scuba diving everywhere I was like, "Yo, there's no way this is real life. They're paying me to do this, I'm in the coolest place." We spent two months in Indonesia one time diving the Coral Triangle and it was just such an awesome experience. And I'm like, "What?"

I'm getting paid to do this?! How is this happening?" So, I think that is really what I've loved.

And I just think about being a scientist, the independence that I do have to ask questions and to figure it out. I'm always learning new stuff. This eDNA was something that was probably my latest tool that I've learned and I'm still learning more stuff about that every day. So, it's just really exciting to be in science, especially when you have an active imagination and you're looking for stuff. You can always find something new for sure.

Alie: Of course, where can people follow you? Obviously, plug away.

Tiara: So, you can follow me @Curly_Scientist and that's on Twitter and Instagram. Black In Marine Science is @BlackInMarSci on Twitter, and then it's @BlackInMarineScience, the full name, on Instagram. And then I can't believe I didn't mention my other organization, A WOC Space which is dedicated to creating safe spaces for women of color. We have a virtual community where we just have different events. So, that's A WOC Space, that's that.

Alie: Well, thank you so, so much for being on. You're the best.

Tiara: Thank you so much, can't wait to hear it.

So yes, ask brilliant people basic questions and follow [@Curly_Scientist](#) AKA Tiara Moore, and happy [Black In Marine Science](#) Week everyone! The link for all the events and hashtags is right in the show notes so dive in. Your timeline will glimmer with cool science and refreshing great people all year long.

We are @Ologies on [Twitter](#) and [Instagram](#), I am [@AlieWard](#) on [both](#). Thank you, Erin Talbert, for adminning the *Ologies* Podcast [Facebook group](#), to Shannon and Boni for handling [merch](#). Susan Hale and Noel Dilworth for all the *Ologies* biz behind the scenes. Thank you to Kelly R. Dwyer for making our website [alieward.com](#). More links will be up at [AlieWard.com/Ologies/ForensicEcology](#) including links to donate to this week's causes.

Emily White of The Wordary makes our professional transcripts which are available for free on our website. Caleb Patton bleeps episodes, also available for free on the website. And every other week we release *Smologies*, which is a shortened version of a classic episode that has been scrubbed of all of my filth and is classroom friendly. You're welcome. So, thank you Zeke Rodrigues Thomas of Mindjam Media and of course Steven Ray Morris for working on those so swimmingly. And of course, to the editor who floats the whole boat, Jarrett Sleeper, thank you for working on this. Nick Thorburn, happy birthday, thanks for making the music.

And if you stick around to the end of the episode, I give you just a little kernel of truth in the form of an embarrassing secret. This week's secret is that I somehow went down an absolute rabbit hole, researching ancient Intaglio rings, which are like carved stone rings that people use for wax seals. And I realized later, I think it was just because of one split-second shot in *Dune*, where someone seals an important contract. And I honestly... I'm the worst, I can't remember the guy's name, can't remember the character's name... I think it was a bad deal they signed. Definitely, I remember the cool wax ring, so there's that. Okay, berbye.

Alie: What was his name?

Jarrett: Duke Leto Atreides!

Alie: I'm sorry.

Jarrett: Makin' a bad deal with the Padishah Emperor!

Alie: He had a great ring, though. Did you see that? It was so big though, too big.

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[A Biodiversity Composition Map of California Derived from Environmental DNA Metabarcoding and Earth Observation](#)

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