Cnidariology with Shayle Matsuda
Ologies Podcast
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Oh heeey, it's your karate teacher, who smells like your college sweetheart, and so you're weird around them, Alie Ward, back with another episode of *Ologies*. This episode was recorded in beautiful Hawaii – ever heard of it? – a few weeks ago. You're about to just get an earful of coral. But, before I recorded it, honestly, I knew neither jack nor shit about coral. Now, all I want to do is stare at videos of coral. Honestly, I used to just consider them to be the really plucky, kind of quirky settings of a snorkeling jaunt. Kind of like a splashy backdrop at a community theater play. Like, "Oh that's nice, but what's happening in front of them? What kind of fish do we have?" *Au contraire*! After this episode you'll be like, "Move out of the way, fish! I'm staring at a polyp." And yeah, it's totally fine if you don't know what a polyp is, we will get to that.

But first, thank you to all the folks that support the show at Patreon.com/Ologies for as little as a dollar a month; you can submit questions. Also, thanks to everyone who buys and wears shirts, and hats, and such, from OlogiesMerch.com. We have some new denim Dad hats, if you need a new lid that says, "I like weird facts, good intentions, and bad puns." It doesn't literally say that. I'm just saying, people will go, "Oh, that's what you're into." Although that's not a bad idea for a hat. Stay tuned.

Also thank you to everyone who tells friends and co-workers about the show, and who rates, and subscribes, and leaves reviews, which you know I read because I deliver a fresh one each week. This week was a fun one for your ol' pal Alie Ward. I brought attention to the fact that a department store was carrying some pretty out of touch and scientifically unsound body shaming dinnerware, and it made, for some reason, international news. It was picked up by some news sites that somehow made this a political issue, so I pointed people toward the Kalology episode with Dr. Renee Engeln to educate people on why body shame doesn't actually promote healthy eating. So, this led to a rare one-star review from a new, curious listener, who must have heard about me on Breitbart. GolfGuy69696969699696 says:

> *Yuck. This podcast claims to be science comedy. I didn't hear either, just a bunch of self-congratulation about not trying to look good. Sad real. Is this what we want to promote in our society? A bunch of slobs?*

Thank you so much, GolfGuy69696969699696. I appreciate your feedback. This podcast has taught me so much about different perspectives and experiences, and I appreciate every single one of you. Most of you. [*laughs*] So, thank you for sharing your perspectives. I learn so much, and it's very much a pleasure to pass that information on and hopefully make the world a little bit more compassionate.

Anyway, Cnidariology. [phonetic: nye-DARE-ee-ology] Totally a word. It's a well-documented, legit term. It's the study of animals that are over 10,000 species, who have 'cnidocytes', which are these specialized cells for catching prey. And where does this lovely, silent-consonant, weird word come from? It looks like when your mom tries to weasel a fake term into a Words with Friends play, and you're like, "No way, Nancy, that's not enough vowels." But it comes from the old Latin *cnidae*, which means a 'nettle'. It might also have ties to old Latvian and Lithuanian words meaning 'to itch', and 'to tickle'. So, corals are cnidarians, they're underwater animals that pose as these beautiful plant-looking things from Mars, and they want to just tickle you to death. I'm already sold! I already love 'em. But let's hear more.

I was introduced to this ologist by your favorite Teuthologist, squid expert Sarah McAnulty, @SarahMackAttack on Twitter, follow her, love her. She invited me to tag along on a squidding trip to Hawaii, a research trip she was doing. A company called Atlas Obscura was facilitating it. They were awesome, they do wonderful science and history trips, it was a joy. Rachel, she led it, I love her. Anyway, one day the group got to take a little boat to Coconut Island, the very island featured in the opening credits of *Gilligan's Island*. This was once a weird getaway for Hollywood-types, but now it's a research station where grad students tend to marine life. We spent the day looking at these gurgling outdoor tanks, and watching a bay of hammerhead sharks, strolling some beachy trails to stations with urchins, and sea cucumbers, and cowrie snails, that are all being monitored by these wonderful marine biologists there.

This ologist got his Bachelor's at UC Santa Cruz, double majoring in Environmental Studies and Feminist Studies; got his Master's in Biology and Ecology, Evolution and Conservation Biology in San Francisco, and is working toward his PhD right now at this famed Gates Lab at the Hawai'i at Mānoa, and the Hawai'i Institute of Marine Biology. The Gates Lab is a coral lab. This dude has his hands full.

The coral were in the middle of a spawning event that very week, but he is amazing and took an hour out of his day to come to my hotel and chat about corals. I was waiting so excitedly in the lobby, and I thought he was maybe five or ten minutes late, which is fine, but it turns out we were in the same lobby, exactly on time, but just perfectly obscured by a pillar. Once we figured that out, it was all smooth sailing.

We talked about what coral even is; why they're important; how he feels about diving; what a dead reef looks like; the state of some reefs around the world; if it's reefs, or reeves perhaps?; the importance of balancing work with being your true self; some advice for aspiring marine biologists. How screwed are coral? What movies get it right? What's up with sunscreens? What is bleaching? And what else can we do to help our hard, squishy pals beneath the sea? So, anchor down. Get ready for a wave of coral info with the amazing Cnidariologist, Shayle Matsuda.

Alie Ward: [*outside with lots of people and noises going on*] It's 9:59, Shayle's due here at 10:00. I'm sitting by the pool. He has so little time. I'm just essentially going to throw this microphone in his face and start rolling before we even hit the elevators.

Were you behind the column?! How long have you been here?

Shayle Matsuda: Like, five or ten minutes. [*laughs*]

Alie: Oh my god, me too. What dorks.

Shayle: But I came in the other side.

Alie: I was literally like ten feet away, reading about micro-plastics, and coral, and wanting to cry.

Shayle: Yeah, it is awful.

Alie: You're like, "Here's my thesis."

[*now settled into a quiet room*] And you are a cnidariologist? Did I say it right?

Shayle: Sure. I was thinking about that earlier. Or Coral-ologist maybe.

Alie: Are corals cnidaria?

Shayle: Yeah, they're cnidarians. That's the phylum they're part of, and what unites all of those animals is their stinging cells. Their cnidocytes.

Alie: Oh, that's the common thread! [*"We must be related!"*]

Shayle: Yeah, so like anemones, or jellyfish, and corals all produce these little stinging cells that they use in defense or prey capture.

Alie: I've already learned so much about corals. I didn't know that they got little stingies! So, what exactly *is* a coral?

Shayle: That's a great question that we think about all the time, actually. Corals are animals, first and foremost, but the corals – when we think of coral reef corals – they're much more than the sum of their parts. So, the coral animal looks white, they have clear tissues and they secrete a white calcium carbonate skeleton. But the reason when you're snorkeling around a coral reef, they don't appear white to us, is because they have symbiotic algae which live inside their tissues that provide up to 95% of their daily nutritional needs. And the algae's color themselves are what we're looking at when we see corals.

Alie: [*mind blown*] Oh my god!

Shayle: And just like you and me, corals have a microbiome. They have bacteria that live inside of their tissues that also play a lot of really important roles.

Aside: To recap: corals are animals, and they often have a calcium carbonate white skeletal structure and a squishy skin bag that can be filled with colorful algae and bacteria pals that live under their skin and provide their nutrition.

If you pitched that creature in a sci-fi series, people would be like, "Mmmmm, no that's too weird. What about just, like, a short, skinnier human, with bigger eyes?" And everyone would be like, "Yeah, yeah, that's more plausible." Now, what is with them being a skin bag?

Shayle: This is the hardest question. We have a term for this, it's called the 'coral holobiont', and that is the coral animal itself, its symbiotic algae, its bacteria, their fungi, their archaea, there are a lot of different obligate symbionts that these corals have that are critical for their life and function.

Alie: So, it's kind of like a skeleton, a soupy mix of goodness, and then a little transparent skin over it?

Shayle: And the transparent skin is the animal itself. Just like trees that grow in the forest, if you count their rings, you get an idea of how old they are, corals actually work the same way. They are constantly secreting this calcium carbonate skeleton and growing, and researchers will actually take a core of that skeleton, and you can actually count the different layers and get an idea of the age of the corals, and also what was going on on the planet at the time.

Alie: Ohhh my gosh. Is it similar to trees, in that there's a ring for every year of growth because of seasons? Or is that different?

Shayle: It's kind of like seasons in the ocean. Different corals will grow at different rates, like different plants as well. In a nutshell, as a coral begins to grow, and keeps putting down these layers of calcium carbonate, we can use things like carbon dating to get an idea of what was happening in the atmosphere and the oceans at those times. It gives us a geologic history of what was happening in these environments.

Alie: Wow**,** so, when you see, let's say, a coral out of the ocean, and it's a piece on a… number one it's not a happy coral. But when you see a decorative coral, are you seeing essentially just its skeleton?

Shayle: Yes. When we say coral reef corals, they're a particular type, a group of corals that live in the shallow waters, that have these algal symbionts that rely on photosynthesis to get their food, but corals are a really large group of organisms. We have deep sea corals that don't have these symbioses, that feed heterotrophically, by eating plankton or things in the water, and a lot of corals can have pigments, and their skeletons do have pigments of their own. So, like, black corals, red corals, things that you see in the stores, that's still the skeleton, but those are the organisms themselves – which we shouldn't pull out of the ocean.

Alie: Which we should leave in the ocean. Now, are those getting harvested just for decorative purposes?

Shayle: Yeah, very often. There's a lot of protections in different places around corals, but it's not everywhere.

Aside: Some figures have estimated upwards of 200 million dollars annually worth of coral is poached from the oceans for things like jewelry and décor. In some places, just taking a coral skeleton bit from the beach is illegal. So, if you're going to get arrested on a beach, do something else. Have a better story, you know?

Alie: So, maybe don't have coral decorations.

Shayle: Yeah. But what you can have… with technology increases, we're doing a lot of work with 3D imaging, you can go to a museum or a tech place and get a coral printed and put that in your house.

Alie: Yes, you can admire them in a way that's a replica!

Shayle: Yeah, absolutely. They're just as beautiful.

Alie: That makes sense. I'm sure you could even cast them and pour a little plaster of Paris in there. We fixed it!

Aside: PS: yes, I did look it up, and there are hollow, coral-shaped molds you can pour plaster of Paris in, and it seems more convenient than getting yourself to an ocean, and then out of jail.

Alie: How long have you been studying corals?

Shayle: I've been studying corals formally for four years, during this degree. But I've been interested in corals for much longer. I studied corals as a volunteer researcher at the California Academy of Sciences, on volunteer expeditions, kind of like Atlas Obscura as a younger person.

Alie: Were you always maybe drawn to the sea? Were you always an aquatic person?

Shayle: That's a good question, too. I grew up just outside of Chicago, where even though I felt like I was growing up on a body of water, Lake Michigan, it's not a marine environment, it's a freshwater environment, so I wasn't growing up swimming on coral reefs. But for me, looking back, my first taste of the ocean was growing up and going to the Shedd Aquarium and seeing all the exhibits there.

I think that's a really common thread that you hear for a lot of us who pursued degrees in marine biology. Most of us in the United States aren't lucky enough to grow up on a coral reef, so a lot of our first exposures to this, especially those of us before the YouTube era, was going to our local aquariums and really seeing these organisms that you don't even read about, out in the ocean.

Aside: If you're wondering, "Where are corals?" I asked Corals.org, and it said essentially, around the equator, plus where currents flow out of the tropics. Like in Florida, and southern Japan, where it's a little bit warmer. They make up 0.2% of the ocean floor, but they're home to – this blew my mind – 25% of marine life. What?! So, if sea animals were like the cool kids, the coral reefs would be like the mall, if this were a movie from the '80s.

Alie: Was there a moment at the aquarium where you thought, "I would love to do that in life."?

Shayle: I'm going to give you my journey story and you can hack this up however you want.

Alie: I love a journey story so much!

Aside: Okay, let's get to know Shayle's science background. Settle in.

Shayle: I had one of those moments where… I was always drawn to nature, to being outside, and playing outside. I was not a video game kid; I was a wound-up getting-muddy kid. But when I got to college, I kind of went a different science route. I studied water policy and sustainable organic farming, and that was something I was really into and really excited about, and marine biology wasn't something I thought I could really do.

I ended up pursuing a different path, I had a dual degree in Environmental Science and Women's Studies, and I kind of went the second route, and kind of worked with youth in nature and underserved communities. I got to this point, in my little bit later 20s, I decided to quit my job, and move out of my house, and sell all of my stuff, and travel, and figure that out.

Something that happened for me on that trip was I finally decided to learn to scuba dive. I'm a really claustrophobic person, so I kind of put that off for a while, and I really explicitly remember that first time I descended into the water. This was in Thailand. I remember being so overwhelmed with how beautiful all the corals were [*angels singing in background*] and how this environment, different than snorkeling, opened up a really three-dimensional, dynamic way. Then I also remember seeing a lot of garbage [*beautiful singing halts abruptly with a record scratch*] on the reef, too.

I was having these push-pull moments of being so overwhelmed with the beauty around me, and so curious about what these animals were, what is this environment that I'm in? Looking at everything. But also, being really struck by how polluted it was as well. From there, I wanted to make sure that was the right choice, so sitting in these little internet cafés, applying to these coral reef monitoring volunteerships to learn a little bit more, to make sure this was the big life switch I was ready to make. I joined one that was in the Yucatán in Mexico, where I went out and lived for three months, and learned to identify all the species of coral out there. We participated in monitoring transects that were then used by local NGOs to compare the protected sites that they had gotten protection for versus the sites that weren't.

That experience really solidified that. I moved back to San Francisco; I went to City College to make up on some coursework that I hadn't done the first time. I was volunteering as a

diver at an aquarium to get more hands-on experience. I started volunteering in a research lab at the California Academy of Sciences, and then I was bartending, to pay the bills. From there, I realized that being at a museum was such an exciting place because you've got researchers studying everything. You've got that, you've got tourists, you've got community folks from the neighborhood who are right upstairs. You can just go upstairs and talk to them about all the really cool things we're working on. And then moving on from there to my PhD, where I am now, at that point I was pretty much sold.

Alie: I have never been, yet, snorkeling in an alive reef.

Shayle: Oh, you've gotta do that while you're here.

Alie: What is that like? You do that for your job and also as a passion, what is it like to be underwater like that?

Shayle: It's so beautiful. It's so beautiful. Corals come in all shapes and sizes, and just like you have your favorite city, or your favorite nature trail you like to walk on, every reef is going to be a little bit different. They have huge structures, and these corals will have these big branching corals, and you look a little closer and you see they're homes to all these different kinds of animals. The more structure you have in the ecosystem, the more different types of organisms you're going to see when you're down there.

It's so exciting, there's so much to see. You'll see your turtle and your shark every once in a while, which is really exciting, but for me, just swimming up to one kind of coral, and just staring at it for a while, then things will start to come out. You'll see crabs that live inside the coral, you'll see snapping shrimp, sometimes you'll see eels, or octopus. You can think of it almost like a metropolis in the ocean. Full of a diverse cast of players.

Alie: When you're doing research, is it ever difficult for you to say, "Okay, alright Shayle, we're done, get out of the water." Are you like, "One more thing!"?

Shayle: Oh yeah, absolutely. Sometimes you forget. There have been times when I… since I work on corals, and I'm working on an experiment right now where I'm focusing on individual coral colonies, I can be upside-down in the reef for like an hour at a time, just staring at this one coral, and then we'll come to the surface and people will be like, "Oh did you see that shark that went by before?" And I'll be like, "What are you talking about?"

It's always still really nice to go out when you're not working, and just really appreciate how lucky we are to be able to see these environments. I've worked with researchers who… I'll go to a coral reef and I'll say, "This is beautiful, look at all the diversity here," and they'll be like, "You should have seen it 20 years ago." Because they're seeing these changes at such a rapid pace, that we're witnessing them in our lifetimes. And that's new.

Aside: So, what is Shayle working on in terms of protecting these bony, soupy, squishy, mysterious, gorgeous little critters?

Shayle: What our lab group is working on is a whole wide range of questions, but we're really curious about what's going to happen to corals under these future climate conditions, and what can we do to intervene to give them a better chance of surviving?

I'm trying to decide if I want to go broad, or my specific stuff.

Alie: I'm going to say let's go broad a little bit, just because people don't know shit about corals.

Shayle: That's true. People don't. [*Alie laughs*] But they're the coolest animals. Coral species are all really, really different. That's something that makes them super exciting and interesting

but makes it also a lot harder to come up with strategies to help them survive. They reproduce differently, some will brood, releasing coral larvae into the water, some will spawn, releasing coral gametes, eggs and sperm, into the water. Some are large and grow in these big shapes, some are really small, even single-polyped corals. And they have very different life strategies. They're so different, they associate with these different types of these symbionts.

What we're really interested in is seeing if, "Are there types of interventions that we can scale up, that managers and conservationists all around the world, who work with these different corals and different coral reef environments that are all widely different, can use as signals for what might happen in the future, or use to kind of help those corals that are out there, survive?"

Some of the things we're looking at in the lab is, "Can we expose corals to non-lethal stressors to condition them to then be put out in the reef, and if they experience these higher temperatures downstream, will that initial exposure help them survive?"

Aside: "What is coral bleaching?" you're asking. I get it. We're going to explain that in a second, don't worry! I got you!

Shayle: With coral bleaching, what's really hard about that is it's this whole balance of how hot, and for how long. So, if there's a really short, high-temperature spike, how does that affect these organisms versus if this is more of a prolonged, only a degree or two above the thermal maximum that they have? How does that affect if they're going to bleach, the severity of that bleaching, and then also their ability to recover afterwards? So, we haven't really talked about what coral bleaching is.

Alie: Yeah, I know, that was my next question.

Shayle: I was like, "Okay, that probably doesn't make any sense yet." Corals have these symbiotic algae that are obligate, that means they're required for the corals to live. They provide up to 95% of their daily nutritional needs. When the temperatures are good, everything is happy, the corals get what they need, the symbionts get what they need, but when the water temperature rises, even slightly above that thermal maximum that the corals can handle, the corals are starting to stress out. ["*I'm freakin' out!!"*] One of their stress responses is to expel these algae. [*splat*] ["*Yoooooouuuu're out!"*]

Kind of how when we get sick, we get a fever, and that's good; it's our body's way of helping protect us. But if that fever gets too high, or goes on for too long, that can actually be detrimental to us. The same thing is true with coral bleaching. So, as the corals are purging out these algal symbionts, it's not just all at a time. You can watch a coral start to pale, losing its color, because as the symbionts leave that white skeleton is showing through. As that's happening, the longer it goes on, the corals aren't getting energy, and they can begin to starve.

Aside: Okay, so under temperature stressors, corals toss their internal friends, and they bleach, because they lose that color. So they're not dead, but they're certainly weaker and they're in danger. It is not cute.

Shayle: What you'll see is, if you go out into a coral reef when this is happening, if you see these corals that are white, you're seeing that skeleton through the tissue, but the tissue is still there, the corals are still alive. If that stressor leaves, the corals have a chance to recover. Those symbiotic communities can proliferate again and the corals will re-pigment and be okay. But if that stressor goes on too long, the corals can die, and we've seen this happen on

massive scales on a reef. Once the corals die, you'll start to see macro-algae growing on top of them, and that's when the structure of the reef environment will start to really break down.

Also, some corals aren't bleaching. Some individuals, like in Kāneʻohe Bay during the 2014 and 2015 bleaching events that we had, there would be two corals of the exact same species, right next to each other, touching on the reef, and one of them would be bleached, and one of them would be visibly totally normal. We're really trying to understand, what is it about that coral's genetic makeup or symbiont communities that is allowing these corals to perform a lot better.

Alie: When you're looking at two different examples of coral next to each other, are those different individuals genetically, or are those different groups of a bunch of individuals? When you're looking at a fan of coral, how many people are you looking at, that are coral?

Shayle: Good question. A coral colony is… You can think of a coral itself as a polyp.

Aside: What is a polyp? Well, it's a squishy little bugger with a feathery head, and it secretes calcium carbonate at its base to anchor it on a surface. Kind of like a cupholder filled with one of those gas station windsock dancers, only made out of Jell-O salad. Also, as long as this train has – toot toot! – made a stop into polypville, it comes from the words 'poly', many, and 'ped', meaning foot. In old Latin, it meant cuttlefish.

I personally tend to associate polyps with bad news about colons, and that's because polyp is a little intestinal dingle-dangle that can grow, and if not checked, it can turn into a tumor. So, get checked.

Okay, let's get out of our butts and back into the ocean though. What is a polyp [*squeaky speed up*] in the ocean?

Shayle: It's like a little mouth, kind of like if you took an anemone... That kind of structure, the mouth in the middle, tentacles on the outside. As a coral grows, it buds off and creates a genetically identical polyp. As those polyps continue to multiply, and spread, and grow, you've got a coral colony that is made up of polyps that are all one genetic individual.

Alie: Ohhh! Do you think that that's all the same person? Or do you think it's a person and a bunch of clones?

Shayle: That's a hard question.

Alie: I understand that a coral is not a person, but do you know what I mean?

Shayle: Yeah, definitely. And that's a hard question. Actually people in the lab are looking at that too. At what life stage are corals able to fuse together and share resources or not? Do some species do this more than others? So that's definitely a really good question. We don't totally know the answer to that. You can't just look at one and be like, "That's three or four genetically distinct individuals." [*"It's like we're literally the same person!"*]

Sometimes, when they do grow up next to each other, you can see kind of like a scar between colonies, where one individual ends and the next one begins. But we're also seeing evidence of fusion.

Alie: How much do you think research has changed in the last five or ten years with DNA sequencing, and how much cheaper and faster that's gotten?

Shayle: So much! It's a really exciting time to be a biologist right now, and asking questions we couldn't afford to ask before, or didn't have the technology to ask before, on these really large scales.

Alie: What about their stingy-ness? Their little stinger-stingers? [*slowed down voice: "Stinger stingers?"*] How is that helping them survive, or thwart predators, or are there predators to coral? Other than just human mishaps?

Shayle: Corals don't have a lot of predators. There's a lot of fish that will… you've probably heard of parrot fish that will try eat the macro algae around coral, sometimes they will nibble the coral too, but for the most part there's not a lot of animals coming towards them to eat them in that sense. They use their stinging cells a lot in prey capture. If you stare at a coral long enough under the scope, and a piece of plankton swims up, you'll see it almost like a Venus flytrap, you'll see the plankton get stuck to the coral tentacles, and the tentacles will pull it into its mouth, and suck it in, and digest it. It's really neat to watch.

If you touch a coral, which you shouldn't do, it will try to sting you too, but our skin is too thick. Other animals, like Portuguese man-o'-war for example, there are stinging cells that can affect us. Corals are pretty safe. Don't touch them.

Aside: Shayle says that one thing that changed in his academic lifetime is that gene sequencing technology has improved vastly. They're able to get hundreds, thousands, millions of reads, getting a much better idea of what bacterial communities associate with corals. Just imagine your haircut, six or seven years ago, like yikes, right? Just imagine what gene sequencing thinks of its TBTs. [*sped up voice: "So embarrassing."*]

Shayle: What this will do is, I can go out there and take a really small tissue sample, extract the DNA, sequence the DNA, get back 10 or 20,000 reads of all these different organisms that we're able to amplify. From that, I can see who is there, [*spooky "Who's there? Who is it?"*] get an idea of what are the functions of these organisms? How important might that be to the health and survival of the coral?

Bacteria have different roles. Like with us, your skin bacteria is going to be different than your gut bacteria, you don't want those to mix. Corals have bacteria that help in defense, in nutrient cycling, things like that. We're interested in what those are doing there, and we can get a way better idea of what's going on now than we could 10, 15 years ago.

Alie: [*robotic announcement voice: "Warning. Bummer question. Bummer question ahead."*] What do you think is the biggest coral bummer for the coral? Would it be a rise in temperature? Or ocean acidification? Pollution? What's their big 'sad trombone'? [*sad trombone*]

Shayle: Corals are dealing with a lot of threats right now. The biggest one being the impacts of climate change. We're seeing this on reefs today in the form of sea surface temperature warming, ocean acidification, as you mentioned. Why this is so bad is that we're seeing an increase, even in our lifetimes, of these massive coral bleaching events worldwide. A coral bleaching event can wipe out entire reef ecosystems in one season.

We're seeing them… it's not just a one-off anymore. Here in Hawaii, we had the event in 2014, again in 2015. The Great Barrier Reef has also experienced these successive events. While we're seeing corals that are able to survive one round of this warming and recover, if you keep on hitting them, what is that affecting?

We've got research groups at the Hawaiian Institute of Marine Biology who are looking at how is the reproduction affected by these events? Are we going to see a lot more

downstream things that are happening? You add things like local stressors, like overfishing, or sedimentation and pollution runoff from a lot of the local environments. Those are the added pressures that corals are facing. It is so important to mitigate some of these local stressors. Like diverting pollution sedimentation – really important. A coral can't live if it's covered in sediment.

Aside: Okay, quick aside. What is up with sediments? Apparently, it's been long known that sediments and coral, they are not happy roommates. Sailors would know that they could enter a freshwater river because that's when the reefs would stop, because the sediment in their outflows would kill the coral. So why can't coral deal with a little river dust? Or erosion? Or storms caused by weather events? Or, say, tsunamis?

In a paper titled "Mechanisms of Damage to Corals Exposed to Sedimentation," researchers say that sediment blocks sunlight, which means that their photosynthetic inner-algae buddies get blocked. There goes their nutrient and energy source. Also, if there's organic material in the sediment, it tends to hog all the nearby oxygen in the water, and then those biproducts lower the pH, and then other organic compounds in the sediment get digested, they release toxic hydrogen sulfide. So, the sediment-covered coral can die in 24 hours. It can happen really quickly.

Even though coral is an animal, just imagine a favorite houseplant. And then imagine coating it in heavy spray paint, and dipping it in an acid bath, and then pumping poison in the room. Your plant would be like, "Wow. Can you not?"

Shayle: The most important thing that we need to address, if we want corals in the future, is climate change.

Alie: Why are coral reefs important? Also, is it 'reefs', or is it 'reeves'? Like 'rooves' or 'hooves'? [*laughs*]

Shayle: [*laughs*] I like that. I haven't heard that actually.

Alie: I always want to say 'reeves' and I know that's not…

Shayle: Reefs. Multiple reefs.

Alie: Like, you know, foots or feet?

Shayle: Fair. Reefs.

Alie: Okay. I've asked an expert, and it's not 'reeves'.

Aside: Listen, if elves had hooves the second halves of their lives, would they be tall enough to reach the shelves where they kept their knives to cut up loaves of bread, or would their wives have to put down the scarves they're knitting to get them themselves? [*chipmunk voice:*] I can't BELIEVE it's not reeves!

Alie: So why are reefs important? Why do we want to save the reefs other than they're fucking gorgeous? And awesome. And fish live there. But clearly, they are important.

Shayle: Yes to all of that. They're really important for a lot of different reasons that are really personal to many people, but also on a community, national, international scale as well. A coral reef environment is one of the most biodiverse ecosystems in the world. They're a bank for biodiversity. Within that, the coral reefs themselves are the breeding grounds and homes for tons of marine life. You've got animals that will come in from the deeper oceans to breed. Fish is a really important food resource for a lot of coastal communities, it's their

main source of protein, for many people in the world. The reef environment is where a lot of those larger game fish reproduce and come back to.

Coral reefs and a lot of our coastal ecosystems are really important for mitigating coastal damage. They absorb a lot of that wave action, that wave power that's coming in. We've all seen really awful things that have been happening in our coastal communities around the world because of flooding, and coastline erosion, and things like that.

Aside: Shayle stresses that he doesn't like to focus too much on the potential pharmaceutical benefits of nature because there are other intrinsic reasons for conservation, but…

Shayle: Something that we're learning more and more about the ocean in general, is that there's a lot of these chemicals out there that can be used to help humans. For me, one of the most exciting moments that I had during my master's degree… I studied sea slugs, nudibranchs, during that time. I was in my advisor's office looking through some old papers, [*pages turning*] and I found this paper where one of… This is the slugs that I studied, really cool animals, they will eat things like sponges or different organisms that produce these toxic chemical compounds, and they will slightly alter them when eat them, and they'll put them in their own tissues, and use them to fend off their own predators. Really cool.

Aside: I did a little digging, and for more information on this, you might want to dip into a light beach read entitled "Selective Toxicity of Persian Gulf Sea Cucumber *Holothuria Parva* On Human Chronic Lymphocytic Leukemia B Lymphocytes by Direct Mitochondrial Targeting." Okay, spoiler alert. I'm going to let Shayle tell you the plot of the paper.

Shayle: These toxins that are anti-microbial, anti-viral, also can be used in biomedical research that benefits humans. So, I'm looking through this box of papers, and I found this paper, and I'm like, "Oh my gosh." I call my mom, and I'm on the phone with my mom and I'm like, "Mom! Guess what! There's this nudibranch that they're studying; that they're using to see if they can treat the adult form of cancer that I had as a kid." [*Alie gasps*] Which is mind-blowing to me, [*"Wait, what?"*] that this organism that I didn't think I was going to study… and I don't study pharmaceutical things or anything like that, but just that this group of animals that I didn't know much about before, could actually have such a personal impact on me. And there's tons of things out there that we haven't discovered yet.

Alie: Oh, my god. What kind of cancer was it?

Shayle: Childhood leukemia.

Alie: Oh my *god*!

Shayle: It's wild, right? I was like, "This all came full circle!" But it's those kind of moments where… the reasons to protect coral reefs, we might not even know all the reasons yet. And are we going to lose these opportunities? It's not because we don't know better, but because we're not ready, politicians aren't ready. It's not for a lack of science, I should say, that we're not making these big changes, but I'm hopeful that we're getting there, getting in the right direction.

Alie: Do you think having had that experience with cancer as a kid changed the way you approached what you wanted to do in life at all?

Shayle: Yeah… Not in the way you'd expect. Everyone thought I was going to grow up and want to be a doctor, that's a really typical narrative that people ascribe to childhood cancer survivors. I think the way that it affected me the most, in my personality, is that from a very

early age, I didn't have this idea of all the time in the world. I was like, "If I want to do something, I have to do it now." From a very early age, I was very… for better or for worse, everything I want to happen has to happen now. It resulted in me being a very driven human being, but at the same time, it also causes a lot of anxiety too. And pressure. I think that it got me really curious about science, about answering questions, and about the fact that – oh man, this story too. [*Shayle pauses for a moment, and sighs.*]

Leukemia is a really interesting thing because for centuries of studying this, we didn't know what caused it. There's been a lot of hypotheses out there that have talked about, "Could it be an environmental thing?" It was only recently that a paper came out with this new hypothesis that it's kind of a combination of things. It's a genetic predisposition, and also, the hypothesis is that babies who are not exposed to the right bacteria in their first year of life were more prone to this.

That was super interesting, because bacteria is another big thing in my research today. There's a lot of work on coral probiotics. I'm studying what bacteria is there, other groups are working on, "Can we take the bacteria we know is helping coral survive, and inoculate them with that at an early age and will that help them down the line?" So, this whole idea that maybe we could prevent childhood leukemia by creating a probiotic cocktail for babies, and then all of a sudden, can we help mitigate coral diseases by also creating a probiotic? The amount of knowledge we're gaining about bacteria in general right now has been a huge driver for knowledge.

Alie: Right, and the notion that it's not necessarily one species you're studying, but its interaction with several species that almost makes it able to survive and adapt.

Aside: Shayle says that some corals even need both bacteria and certain viruses present to survive these thermal events. So, the symbiotic connections go deep. They get complicated. Kind of like a group of adults who've been friends since college, like a girls' weekend without Steph, things at a coral party just aren't the same without both bacteria and viruses.

Shayle: The ocean is full of different things, and we're looking at a lot of interactions. How many partners need to be in play to get this resolved, or to prevent something from happening? It's a really exciting time to be studying all of this stuff.

Aside: Home to 25% of the world's marine species; potentially home to a cure for cancer; weird, interesting, alien-like, live sculptures full of other beings; and also, our new friend coral is just plain really pretty and nice to look at. So, there's that factor. Shayle explains:

Shayle: They're also really important for tourism and the economy. That's also a really great way to switch the way that we think about our economy. Instead of extracting from the reef, and damaging the reef, we can actually do eco-friendly tourism. Bring people, educate people, to see the reef. It's hard to find an appreciation for something that you have never seen before. We can all kind of relate to that. We all have those moments where you saw something for the first time. Any place in nature, we can have those kind of moments. I think that's really important, also.

Especially here in Hawaii, the coral reef ecosystems are incredibly important culturally. There's a lot of stories, a lot of history wrapped up in these ecosystems. There's a lot of reasons to protect them.

Aside: With 85% of the US coral reefs surrounding Hawaii, there's also a really big cultural necessity of protecting and preserving those ecosystems. There's a piece called "Puka Mai He Ko'a: The Significance of Corals in Hawaiian Culture," and it's featured in the book *Ethnobiology of Corals and Coral Reefs.* With an 'F'. Reefs. Fine. The lead author of it, Toni Makani Gregg writes:

> *Hawaiian people consider coral to be an 'akua', that provides birth and death to both the people and the islands, and possesses much 'mana', the essence of spirituality. Corals are considered the beginning of life and are thus the most ancient ancestors of all living things in Hawai'i.*

That's something that Shayle seems to approach with a lot of reverence. He seems to have a lot of empathy, which may be from feeling conscious of ping-ponging between a few science subjects before he landed on reefs, but also, he blazed through grad school with challenges that most of us don't face.

Shayle: Not only did I not have a direct 'go to undergrad, go to your master's, go straight to your PhD' experience, but I'd experienced also a lot of the obstacles and challenges that folks who don't typically see themselves in science face, as well. That's not something that you would necessarily get from looking at me today, and for me, I experienced a lot of sexism when I was younger. So, I didn't transition until I was in my masters' program. I had the experience of being a woman in science for my entire coming into science.

In high school, I was put on 'not the honors' science track, and it took me a while to realize that this is something that happened. Those experiences in particular really came to a head for me when I showed up at my PhD program well into my medical transition, and all of a sudden had access to conversations and space where people really let you know what they really think in ways that I didn't before.

It has been a very interesting experience to see on the other side, really a lot of the things that I thought were happening, the old ways of thinking, and kind of the gatekeepers for a lot of opportunities in STEM from this point of view. I think taking a longer time in your journey is something that's very typical for folks from many underrepresented backgrounds in the sciences. Especially after decades, centuries, of being excluded not only from science careers, but also from science research. Look at the medical industry. It's a great example of that.

Aside: PS: side note, I had heard that women weren't included in some medical research trials, but I didn't know how big a deal, or how recent this was. Cell phones existed by the time a law called the National Institutes of Health Revitalization Act of 1993 passed, stating that:

> *The director of NIH shall ensure that- A) women are included as subjects in each project of such research; and that B) members of minority groups are included in such research.*

A 2016 article in, *Pharmacy Practice,* said that:

> *When studying diseases prevalent in both sexes, males, frequently of the Caucasian race, were considered to be the norm study population.*

That was a direct quote from a journal article. But heads up, I didn't know this until this past year, but the word 'Caucasian' has super racist origins. It's no longer widely used. So, scrap that, 'white' works.

Nearly 20 years ago, the Institute of Medicine clarified, and made a really important distinction between sex and gender; gender being the self-representation, social, and cultural views of sex. So, if anyone ever tells you that they know your gender based on your body, tell them that, "Science says that is hogwash, thank you very much." Also, Shayle says having a mentor you trust and respect is so important. He had situations that called for allies, like preparing for fieldwork in countries where certain identities could put you at risk, or navigating passport issues, things that some of us might really take for granted.

Shayle: It's really hard to be alone and struggling. For me, the hardest things have been personal in this journey. Science is hard, but I have lots of people to talk to about my experiments. I think that besides all the systemic things we need to do to help make STEM actually more inclusive, we need to find our communities and lift each other up in that sense.

Alie: Do you find that maybe underrepresented folks tend to have a little bit more imposter syndrome?

Shayle: Oh, yeah. Oh, imposter syndrome, yeah. Yes, definitely. Sometimes you see it, it's really obvious. Like sometimes you'll walk into a room, and every person of color, probably every woman, probably every LGBTQ person, when you walk into a room, whether it's like a new class, or a conference, you kind of look around the room and look for your allies.

Alie: You're like, "Who's got my back here?"

Shayle: Imposter syndrome is never a stand-alone feeling. It's built up over so much that's going on in the world. Are there people like you that you have as role models? Are the interests of your communities being addressed in societal science?

Alie: Did you end up at lab that you felt you had a little bit more community? Also, you work on Coconut Island, which is a beautiful place in Hawaii. It's also this little isolated pocket of marine science. How did you end up there? And what was your feeling when you found out you'd be researching there?

Shayle: It's a good question. I only actually applied to one program for my PhD. 100%, I applied because I wanted to work with Dr. Ruth Gates, who was an excellent coral biologist, and also someone who really valued science communication, and connecting to communities and the public, and inspiring people to care so deeply about reefs. Those were two things that were very, very important to me.

Also, it was really important to me to work in a large collaborative lab, where there was a lot of collaborative work, and sharing of ideas and support, and also in a place where I would feel safe. And 'safe' means access to safe health care, finding community on the islands, university, or a place that actually has anti-discrimination policies in place.

There's a lot of places that don't. I have a lot of friends that are part of universities that are in places that you can be thrown in jail for using the "wrong" restroom. "Wrong." We've seen some really great response around that from the scientific community cancelling conferences in areas that are putting up these really discriminatory policies. That's wonderful. The UC system has done a lot of great work in that sense by saying, "We're not funding travel to these places."

Aside: One professional mentor who meant so much to Shayle was Dr. Ruth Gates of the Gates Coral Lab he's at now. She was a veteran coral biologist. She apparently had such a zeal for her work. She passed away just this past October at age 56, of cancer. When we

went and toured the labs in Hawaii, Ruth's name was brought up a lot, and you can tell that she is dearly, dearly missed. But it seems like he ended up in the right place.

Alie: Oh, and also, before Patreon questions: it's a big day for you, because they started spawning last night. What kind of…

Shayle: Oh, that's funny because I thought, "Because it's Pride?"

Alie: Oh yeah! Happy Pride! [*both laughing*]

Shayle: Yeah, they did!

Alie: It's spawn-a-palooza right now!

Shayle: It is. Something really amazing about corals, as if there's not enough amazing stuff, is coral spawning events. Corals are sedentary animals, you're not moving around to find your mates, you're in the ocean, how are you going to reproduce, besides fragmenting off? The way it works, it's kind of this combination of cues. It's the moon cycle.

[*clip from QVC broadcast*]

Shawn Killinger: …from the Moon, looking back at the earth.

Isaac Mizrahi: From the planet Moon! From the planet Moon.

Shawn Killinger: Isn't the Moon a star?

It's the temperature, it's the pressure in the environment, that will all come together and cue the corals to release their gametes into the water column. For the coral species that we study, the rice coral, *Montipora capitata*, here in the lab, they spawn two to three months during the summer, on the night of the new moon, and a few nights after. If you're lucky enough to be out in the bay, you kind of peer over at around 8:45 pm, and you'll start to see these little cream-colored bundles, slowly floating to the surface of the water, the size of a pinhead. [*"It was so little."*]

On a really big night the entire surface will be covered in these little white dots. After about half an hour, the wave action will cause them to burst, the little tiny eggs inside will start to float, the sperm will sink, and in the next day or so, there will be swimming coral larvae, these itty-bitty little jelly beans. Those larvae will swim around and look for some suitable substrate to metamorphose into the first polyp, which will hopefully grow into many, to form the next colony.

We didn't get a lot of spawning in June. Usually we see it June, July, August, and since we didn't see a lot in June, we thought maybe this will be our big month. Going out last night, we decided to take a quick look on the bay, just to see what we saw, and there was a pretty big event. Being a coral biologist, you have to be ready to respond to whatever's going to happen, so we've kind of changed our plans, and we'll go out and see what we can do.

This is a great time for us, because a lot of the questions we have about early life stages, we can only ask during the summer months. Right now, this is a really exciting way for us to get a lot of genetic diversity, to run some of these pre-conditioning tests, to see if you cool them down, if you heat them up, what's that going to do to their settlement or survivorship?

Alie: So, you can kind of scoop up and run them in tubs in the lab and see how they respond best?

Shayle: Yeah, the technology that we use for DNA sequencing is one end of the spectrum, and then on the ground, in the lab, it's very DIY, you know, grab some buckets. We make these big scoops out of these plastic shoeboxes, where we cut windows and hot-glue on mesh and use those to scoop out the bundles. We carefully put them into little containers where they'll do their fertilization, and oftentimes we'll even just leave them to sit overnight in buckets, and carefully clean them out the next morning. But a lot of our tools are stuff that we kind of have to come up with on the fly to use. They don't sell coral spawning supply kits. [*both laughing*]

Alie: There's a lot of Home Depot 5-gallon buckets.

Shayle: Yeah, lots of buckets everywhere, at any lab, absolutely.

Aside: Shayle wrote a blog post last June about coral spawning, and in it, he described setting out on the night of the new moon, with life jackets and a first aid kit, and head lamps. They use red lights so they don't interfere with any lunar cues for the coral. They have as many 2.5-gallon buckets as will fit on the floor of a small whaler boat. He says, "Our tools are not glamorous, but they get the job done." There are photos of these milky trails of coral bundles popping to release eggs into the water and a glimpse of what field research looks like. So, for more on that, I'm going to link the post in the show notes and on my website.

Now, we're about to ask your Patreon questions, but before we do, a few words from sponsors of the show. These sponsors make it possible for *Ologies* to donate to a charity of each ologist's choosing. This week, Shayle picked two. The first one is Paepae o He'eia, it's a private nonprofit organization caring for an ancient Hawaiian fishpond located on Oahu, and its vision is to perpetuate a foundation of cultural sustainability, and to provide intellectual, and physical, and spiritual sustenance for their community. This fishpond serves as a place of learning to weave ancestral knowledge together with Western ways of knowing to achieve their goals.

A second donation went to Point Foundation, and PointFoundation.org is the nation's largest scholarship granting organization for LGBTQ+ students of merit, and Point promotes change through scholarship funding, mentorship, leadership development, and community service training. Links to both those charities, and to our sponsors who make that possible will be in the show notes. Some things I'm liking this week:

[*Ad Break*]

Okay. Your questions.

Alie: Now, first question we got from Lauren Krupens and a bunch of other folks, including Jessica Frizz, Jennifer Alvarez, Caitlin Fitz Gerald, Jenna Martin, Ira Gray, Jessica Czarnecki, Dakota Harriman, Crystal Mendoza, Topher Henness, Kaycee Kaiser, and Jessie E Scott, asked: How harmful is sunscreen to coral? This is a big question. How harmful, or what does it do? Oxybenzones? Certain non-mineral sunscreens?

Shayle: [*sighs*]

Alie: It's a tough question.

Shayle: It is a tough question. People have seen movements in different coastal communities to ban unsafe sunscreen, and this is a field of research that is beginning to grow, it's a new thing that we're seeing. It's really important to consider these stressors, these daily things that we're doing that may or may not be harmful to reefs. Considering what sunscreen you use,

just like considering any type of chemicals you're introducing to a natural environment, is a really important thing.

However, [*pause*] what we are concerned about is that, in the grand scheme of impacts facing corals, it is a very small drop in the bucket compared to climate change. That's always a really hard thing. The research is ongoing, with how bad these chemicals are, and the effects that they have, but the danger is when that's where we stop. Considering your sunscreen choice is a really great point of departure. Same thing with plastic straw bans, things like that.

For people who might not consider how their daily actions affect coral reefs, to begin to learn more, and to understand "how are my actions affecting the reefs? What else can I do?" and to figure out what each of us are doing every day, that affects the planet; if that's the stopping point, that's a really dangerous thing. Just changing your sunscreen is not going to slow down our loss of reefs.

Aside: Afterwards, Shayle sent me a link to a piece written just a few weeks ago by two coral scientists in Florida, who said that people are being led to believe that there's extensive scientific evidence about the impact of oxybenzone on corals, and it's simply not true. It went on to cite three main factors that are actually killing coral: climate change; there are biological changes like diseases and invasive species. There's overfishing, the overfishing depletes the fish that eat the algae that overgrow on corals. There's also water quality issues, like wastewater and land runoff, that dump those pollutants and sediments into the reefs. So, [*slowed-down voice*] sorry everyone.

Alie: So, don't just change to a mineral sunscreen and be like, "Nailed it!"

Shayle: Yeah. Actually… I got permission to tell this part of the story. An example of that is, a colleague of mine recently went into a local classroom to talk about corals and the research we do, and she asked the students, what was the biggest threat facing corals, and everybody said sunscreen. That's the "oh no!" moment. She spoke to the teachers, and they were like, "We had no idea! That's what they've been telling us, so that's what we've been telling our students." That's not good. It's a great way to get people to understand that small actions that we take every day can have really big impacts, however, in no way… We *have* to focus on climate change.

Aside: This next question was asked by a listener who started making these beautiful paintings inspired by episodes, so to see them, you can check out the *Ologies* Instagram, and follow her too, because she's wonderful.

Alie: Maria Hancox wants to know: How excited are you that Pantone's Color of the Year is coral?

Shayle: Super excited! Any time that corals can make it into social media, get across people's radar, "Do I want to learn more?" it's really great, because there are a lot of animals in the world that are endangered. Why corals are such a great organism to talk about these kinds of things is that they're gorgeous. Having companies celebrate coral, bring attention to coral, is always greatly appreciated and really exciting.

Alie: I didn't know that it was Pantone's Color of the Year. I'm excited!

Shayle: It is. That's great. We're always excited.

Aside: Also, side note, huge ups to Pantone for naming the color not just coral, but Living Coral. 'Alive, Non-Dead, Non-Bleached, Thriving, Magical Coral', was too long, but Living Coral works.

Alie: Sarah Terry asked: What makes them so colorful? Is it that symbiosis?

Shayle: Yeah… but, I feel like everything I'm saying is like, "Except for this one, it does something totally different that we didn't expect!" Yes, in general, a lot of the color we're seeing are these symbionts. However, corals also do produce their own colorful pigments. You can take a black light, and shine a black light on corals, and oftentimes you'll see florescence. If you've seen *Chasing Coral*, the movie, you'll see during some of the bleaching events, as the corals are bleaching, they actually will start to glow in these blues and purple colors. There's been a lot of hypotheses on why they're doing that. It could potentially attract new symbionts, it could be their own sunscreen method to protect their own tissues, so we're still learning more about that. Some species are able to also produce their own pigments themselves.

Aside: So, that was a doc called *Chasing Coral*, and if you want to see what coral bleaching looks like, and just get hyped to mobilize other folks to care, this is a great doc to watch.

Alie: Are there any movies, any fictitious movies that honor, or really fuck with coral, that you're like, "Come *on*!"?

Shayle: I was actually really impressed with the coral in *Finding Nemo*. They did a really good job. There's some other inaccuracies in their biology, but I remember when I first saw it; it came out right when I was graduating college. They did a really nice job with the forms. So I was like, "That's pretty awesome." Corals don't tend to get a lot of spotlight in a lot of mainstream films.

Alie: I'm going to go on IMDB and find out who the coral consultant was. Chances are, you probably know them.

Aside: Quick aside. I tracked this down, and I *think* it was a very passionate ichthyologist who's done research on the Great Barrier Reef, now at the University of Washington, and he's credited as, "Adam Summers, fabulous fish guy" in the special thanks of the 2003 film *Finding Nemo*. And yes, I found him, I called his office to ask him, he was out of the office, so I sent him an email, I didn't hear back from him yet, but yes, I do want to be his friend.

Alie: Brooke Reutinger wants to know: Does coral have a smell?

Shayle: Right now, if you go out into Kāneʻohe Bay, you can smell their gametes. Usually yeah, after a big spawning event, you can definitely smell them. [*"Noice!"*] Coral mucus… I feel like the longer you work with anything, the more you gain a nose for it. Underwater we're not really smelling anything, but once you're covered in it, it's definitely a little earthy stink.

Alie: A little earthy. A little musky.

Shayle: That's actually a great question, because while we might not smell the corals, a lot of marine organisms use chemical senses to interact with their surrounding environments and things like that. There's a lot of smells going on in the water.

Alie: [*silly accent*] In ze oceans!?

Aside: This next question was also asked by listener Grayce.

Alie: And Aliza B wants to know: What role does concrete truly play in the health of our coral?

I know nothing about this.

Shayle: Concrete's composition, and we'll look this up, it has a lot of the same attributes as calcium carbonate coral skeletons. It's a really great substrate because it's also kind of porous, so a lot of times you'll see… I think it's in Mexico, where they have that underwater sculpture installation made out of concrete, that different corals and sponges are all recruiting to. It can actually act as a pretty good substrate. It's a really great substrate for artificial reefs.

Aside: He's talking about an underwater museum in Cancún, Mexico, that consists of nearly 500 sunken sculptures, and they serve as a base for new coral. Why did they make this, you ask? Because too many tourists were snorkeling in the natural, local reefs and destroying them, so they were like, "Hey, hey! Hey, look over here! Look at these! Look at these sculptures!" And it worked! So, people go *there* now. And! coral can grow on it. Ding! Perfect.

Also, some of the sculptures serve as scathing environmental critiques, like the one of men in tuxedos burying their heads in the sand. Oooh! A burn so sick, it scorched underwater.

Alie: Zane Liebrum wants to know: Hello, [*"Oh, hi!"*] is the news about the Great Barrier Reef being declared dead, true? And if so, is there anything we can do about it?

Shayle: That's a great question. There was an article that came out, I think a couple years ago now, that declared the Great Barrier Reef dead. It's not dead. That's the answer. However, it's not doing so great. That's why articles like that can be challenging to the overall conversation. We don't want everyone to say, "Oh good, it's not dead," and move on. But the Great Barrier Reef just experienced two horrific bleaching events, back to back. A new paper by Terry Hughes's group out in Australia showed that the recruitment of baby corals to the reef, post those events, has significantly declined. That's one of those… not only are we dealing with the impacts of dying coral on the reef, who's going to replace them? These are the smaller impacts that we're looking at.

The Great Barrier Reef did experience this massive bleaching event, in some regions lost 50% or more of the coral on the ground. They're trying to come back. Different sections of the reef are still healthy. You can still go out and see corals in the Great Barrier Reef. But if it keeps getting hit by these events, there's not going to be enough time for things to recover, to go back to what they were.

Educating yourself on the politicians, and on the laws and bills that are coming up that would directly impact the reefs here, where we are, that's where we have the most sway, is a really important thing. Going to town halls, also. Not just voting, but actually showing up and becoming parts of the conversations that are directly influencing the legislators in your own area can be a really good way to start. Also, if you're going to a place like the Great Barrier Reef, essentially, voting with your dollar. Doing your due diligence to look up operators that are eco-friendly, that some of the funding from that might actually go to research reef restoration. Making sure that your footprint in those spaces are supporting organizations that are doing it right.

Alie: Our tour operator for Atlas Obscura was saying that they don't provide fins because so many times tourists will just absolutely slap a coral reef with a fin. I thought that was great, I didn't know that.

Shayle: Yeah, definitely. And that's the thing, some corals, their structures are big. Ask any surfer, they hurt if you get hit by one.

Aside: Okay, side note. I just watched a bunch of videos of surfers bailing on coral. Not only are the corals hurt but, hoooo man! Oh, the blood! Ohhh, the scars! There was one video of a Tahitian pro surfer who got a pretty bad scrape-up, and they show her on the boat afterward, and they have to brush the coral bits out of your skin, and then for some reason, they have to rub citrus in it. She's biting a towel. I cannot imagine the pain.

Other remedies for this reef rash, according to this surfer message board that I just totally lurked on, are hydrogen peroxide, alcohol, people use iodine, others say just baby shampoo and scrubbing it with a toothbrush, and anti-bacterial ointments work. You have to treat it right away, because you could be left with a staph infection. Which would hella gnar-gnar, not in a good way. Please note, I am neither a surfer, nor a doctor, so consult one of the two, or both. Also, as for the coral, I don't think they have a strategy for first aid.

Shayle: They're also super fragile. Some of them have those really nice branching shapes. Just a tiny kick, you could kick over a colony that's been growing for a hundred years with one kick. So, that's a great way to educate people on that. A lot of people think they're rocks, so they're flailing around like, "I'm gonna go stand on that." And the polyps are just thin layers of tissue.

Alie: And you can crush them. Like a face bone.

Aside: Other patrons, like Aarika, Sarah Peck, and Izzy M. had questions about Shayle's favorites.

Alie: Hufflepuff Hillary wants to know: Which reef has been your favorite to dive in? [*silent pause*] Do you have a favorite? Can you pick a favorite?

Shayle: Oh man. [*Jeopardy theme song begins playing in the background*]

Alie: All the other reefs are gonna be like, "Really??"

Shayle: I know. I know… what's a favorite? [*Shayle is still thinking, Jeopardy theme song still playing*] Ooooh. This is really hard. So… [*theme music ends*] I was lucky enough to dive the Blue Hole in Belize, which is a big atoll that you can just sink down into, and there's all these sharks everywhere. That dive, and the surrounding reef there, I saw way more… For someone like me, in this environment, if you see *a* shark, that's really cool. Like, one. And that's because we don't have as many anymore.

Sharks are actually a really good sign of a healthy reef environment. You want to have all the levels of the food chain. I had never been in a reef before, in that environment, where there were so many apex predators, just living there. The coral was beautiful, there's diversity of fish, but also, I got to see it all together. So, for me, that was a really exciting moment.

Alie: Whooo! Oh my gosh. Have you ever been scared of a shark bite, or are you like, "Meh."?

Shayle: No, not really. Sharks are doing awful. Shark-finning is decimating world shark populations. We're talking about, how do we change these laws? How do we ban shark-finning? How do we not allow shark fins to be sold in commercial senses in our country? It relates to our emotional reaction to sharks. Are we scared of sharks? The vast majority of all shark species want nothing to do with us. They've got very tiny mouths, they could be bottom feeders, or they're just as scared of us as we are of them.

Anytime you go into the ocean, or nature in general, you have to respect the environment where you are, and respect the organisms there. It's always important to know what the threats are, or what they could be, or what dangers there could be any time you go. So, when I go diving in a new place, I look up what organisms could I possibly encounter. If you work with a good operator, you go to areas that are safer.

I always feel incredibly lucky every time I have the opportunity to see sharks anywhere. They're beautiful. They're doing their own thing, they're swimming over there, not disturbing me. There are some shark species that might have a case of mistaken identity. If we're swimming around like a seal at the surface, in white shark territory, they can come up and poke you to see if you're food or not. Their strategy for getting food is, they don't have arms, so they use their mouths to grab onto things. So, they'll come up and if they think you're a seal, will try to take a bite, but people aren't dying of… They're not being eaten by a shark. Unfortunately, it has to do with succumbing to a wound from that shark bite. But I'm not scared of sharks and you shouldn't be either.

Aside: For more on this, see the Selachimorphology episode on sharks. Also, I snuck in this teeeennny, tiny question about itty bitty garbage. Sorry this one's a bummer, but it's good to know.

Alie: How about plastics and corals? I was reading a little article when we were waiting for each other on opposite sides of a pillar, about microplastics being found in corals.

Shayle: Yeah, so plastic in general is awful for the marine environment. You hear these stories about straws getting stuck up turtles' noses, or animals getting caught in plastic bags, or eating plastic bags thinking that they're jellyfish or other kinds of food, so those are a big problem. However, what we've learned recently, is that the plastics, as they start to break down, so they're not necessarily visible to the naked eye, these microplastics are having a huge impact on these lower trophic levels.

A lot of the plankton are eating the plastics, then the larger animals are eating those plastics, and there have been some studies that are looking at, are corals eating these plastics as well? And what does that mean? There's no nutritional value. If you can't expel those, then all of a sudden there's something inside of your gut taking up space where nutrition could be. These are huge, huge problems, that are also, unfortunately, global.

Alie: Anything that you've seen research-wise in the last few years, or any turn arounds that have given you hope?

Shayle: [*silence*]

Alie: You're like, "No, everything sucks." [*both laughing*]

Shayle: Yeah, absolutely. Like I was telling you earlier, when you see a coral bleaching event, and you're like, "So many of these corals died." There's all those corals that didn't die. The corals themselves, there are some winners, there are some survivors. That's really exciting, because without any intervention from us, there are organisms, there are individuals, that are already able to withstand these.

You look at an environment like the Red Sea, which is on average way warmer than anywhere else, and corals that are living in up to temperatures that they can't here. The difference is that this happened over geologic time, whereas we are speeding things up. Can these animals keep up for that? But just the fact that these things exist is very exciting.

Ten years ago, if I had said, 'coral bleaching' to someone on the street, they'd be like, "I have no idea what you're talking about." But there's been a huge push in education and excitement around coral reefs in the last handful of years, where people have heard about this. People know, people are starting to really care about it, and understand why it's important, why it's important to them, why they want this for their future generations. Corals have really come into the national, international conversation in a way that they hadn't before. Because of that, there's a lot more hope for these big, overarching changes that we need on a systemic scale, to potentially start to happen.

Alie: I always ask these last two questions. What's the shittiest thing about your job? What sucks in a way that's either annoying… is it moldy, wet suits? Is it early mornings? Or is it more infrastructure? Like, what *suuuucks*?

Shayle: The thing that sucks most about being a coral biologist is watching something you love die, and not being able to do anything about it. And that's something that's shared by, probably everyone in our field. I love corals, biologically speaking. I'm so fascinated by them, they're such interesting animals, but so much of my research is around keeping them around.

Anytime you dive on a reef that's bleaching, or a reef that's been devastated by any kind of impact, especially one that you'd seen flourishing before, you have an emotional reaction. It's a very devastating feeling. That pressure of… not just, "If I don't finish my dissertation, then I don't get to graduate." But so much of this work that we all are working on is going to have an impact right now. Or not. And are we doing it right? Are we asking the right questions? And that's definitely the hardest part, for sure.

Alie: What's your favorite part about your job? Or about corals?

Shayle: Oh man. We could do a whole podcast on that. My favorite part of my job is – I'm answering it in two parts, which I know you're not supposed to do.

Alie: No! Answer it in however many parts you want.

Shayle: It's the daily life, and the people I work with, for sure. Like in the community. When you're working on an issue that's this important, people are really passionate, and really excited. And because we're trying to solve something really quickly, it's a very creative place to be. People are coming up with really creative, out-of-the-box solutions. And being able to be part of new technologies that are coming in, new ways of addressing these questions, trying just crazy ideas that just might work, is something that maybe we might not have had the luxury to do on a system that is doing fine somewhere. That kind of creative thinking and passionate environment is a really exciting place to be. That's something great.

Also, I take a boat to work every day. I can just walk into the water and see the reef. While that's amazing for research, and asking questions, it's also a luxury. I feel so lucky to be able to be in a place where my study environment is right here, and I can appreciate the beauty of the reef on an everyday basis.

Alie: Maybe that's why marine biologists are a little bit more chill.

Shayle: I don't know. I feel like we're really chill, and then we're also super stressed out.

Alie: That's a good point. You're doing such great work. I'm so excited that I got to talk to you.

Shayle: Thank you.

Alie: Thank you for taking a sliver of your time, I know that it's a busy day for coral. Are you going back out tonight?

Shayle: I am, yeah. Definitely.

Alie: Are you excited?

Shayle: Very excited.

So, ask smart, amazing people sometimes stupid questions, and also, if you can, please vote. Let's try to turn this boat around. Also, for more about Shayle, you can follow him @Wrong_Whale on Twitter. That will be linked in the show notes. We're @Ologies on Twitter and Instagram. I'm @AlieWard, on both. And thank you to Atlas Obscura for the really wonderful time in Hawaii learning about all this stuff. And thanks to the world's most charming teuthologist, Sarah McAnulty, aka @SarahMackAttack on social media, for hooking me up with this really wonderful cnidariologist, Shayle. I look forward to calling him Dr. Matsuda soon.

Thank you also to Boni Dutch and Shannon Feltus, they have a comedy podcast called *You Are That*, if you like funny amazing people. They also manage my merch at OlogiesMerch.com.

Thank you to Hannah Lipow and Erin Talbert for adminning the *Ologies* podcast Facebook group. I was also recently told there's an *Ologies* podcast subreddit now, just in case you're on Reddit and you want to discuss episodes and share weird ological facts there. So, hi Reddit! Hi!

Thank you to Jarrett Sleeper of the *My Good Bad Brain* podcast for assistant editing and being wonderfully supportive on not-the-easiest week. And thanks to the host of the podcasts *See Jurassic Right*, about dinos, and *The Purrrcast*, which is all about kitties, Steven Ray Morris, who is a pillar serving as a sturdy substrate in putting this all together. Apologies for being a day late on this one, folks. I hate that it's late. I was in New York, I felt really under the weather, and slept 12 hours a day two days in a row, so I just needed a wee extension. The theme music was written by Nick Thorburn, of the band *Islands*, which is a great band.

Now, if you listen until the end of the show, you know I tell you a secret. This week's secret is that when it comes to apples and baked potatoes, my favorite part is the skin. Like, I want to eat other people's discarded potato skins at the table. I'll eat the whole shebang, but I'm like a goat. I just love the chewy roughage. I don't know why. But, also, in college, my favorite thing to eat in the dining hall, of all the things they had in the cafeteria, I loved baked potatoes with soy sauce and then sour cream on top of it. I think of it often, and I'm like, "Yeah, I still stand by that combo, it was pretty tight."

Berbye!

Transcribed by Lauren Fenton.

Some links which may be of help:

Donations went to paepaeoheeia.org and pointfoundation.org

Shayle's blog about coral

Shayle's bio

Can you legally take coral from a beach?

Sea slugs and cancer research!

More about sea slugs and cancer!

Coral in Hawaiian culture

Inclusion in scientific research

How sediments affect coral

Corals and sediments — river mouths and a Darwin quote

Coral Bleaching on the Great Barrier Reef

How to make artificial coral

Coral Reefs 101

Atlantic article about Dr. Ruth Gates

"Finding Nemo" Fabulous Fish Guy consultant

Reef rash & surfer's orders (bust ask a doctor first)

Underwater museum in Cancun

"Chasing Coral" documentary

Living Coral: Pantone's 2019 Color of the Year

Sunscreen + reefs: Two scientists weigh in

It should be "reeves" okay

For comments and inquiries on this or other transcripts, please contact OlogiteEmily@gmail.com