

Welcome to the sargassum podcast. I'm Robby Thigpen, I'm Franziska Elmer and I am Mar Fernandez and we are your hosts for today. We are going to share with you the latest ideas and concepts about sargassum and sargassum beaching events which have become an international challenge.

Welcome everybody to the sargassum podcast. Hi mar and hi robby how are you doing today? hi guys, nice to see you! i'm doing pretty good. I'm happy to see my long-lost friend again and it seem like it's been ages , and has been ! Summer holiday was in between. I know it's gonna be nice. I wish I knew what that felt like. How was your holiday robby? I heard you were visiting fran. Well I got to visit her for a little bit but I wouldn't say that that was a holiday, I was working. The only time I wasn't working, is when I was with them, and all the rest of the time I worked every day. We met with the university, we met teachers we you know had to get in and meet with some marine megafauna biologists in Chetumal tomorrow and the university of Quintana Roo and we met with the secretary of education with the department of education and we got some research agreements signed. We're working on a couple more and you know. I was busy busy busy but

yeah when I was with Franziska and Joseph, they had lots of rum. I didn't accomplish anything while I was there and it was awesome. But we did go to a meeting together, so i think you did accomplish something. So when Robby was here beginning of July right, here in Playa del Carmen in Mexico, we already had I don't know how many weeks of brown water and I haven't been in the ocean for a very long time. So of course we wanted to do something fun with Robby after showing him the beach and how brown the water was and how the sargassum was piling up. One of the people living where i'm living told us in Puerto Morelos the beach is clear and the water is clear and the beach is clean. So I said we gotta go because I wanna get in that water. So on the Saturday that Robby was here we went to Puerto Morelos and we got to enjoy the beach and we got to enjoy snorkeling and being in the ocean. Robby saw a barracuda hunting. Right, i mean I've seen him lots and lots of times, this was the first time i ever saw one go sssip

and then there was just a shower of scales coming down from his mouth. Then on Sunday, we had a bit of a late start but we wanted to go to cenote so me and Robby in the heat of Quintana Roo, as it's very hot. We went into Colectivo, we drove about a half an hour out of Playa to go to the place where there's three different cenotes you can visit. We went to the first one we wanted to go to and they said oh we're full we have reached capacity for today. So we went to the other two, to see if we could go to any of those and it was the same thing. So we had to go back home and ended up swimming in the tiny tiny cenote next to the beach in Playa Esmeralda. Where there's just a lot of locals with their kids bathing every day. I was just gonna say that it's actually amazing how it has changed, because I remember like six years ago, it was one of the first trips I did with my husband and we went diving in one of the cenotes and there was almost no one there and it was beautiful. It's amazing to see how quickly these things change, right? That people suddenly are going in masses to the cenotes. So I'm very excited about the interview we're having today because as you just said Fran this is exactly the topic we're going to talk

about today. Yes I'm really excited as well because I've been living here all summer and it would be I'm really excited to hear the professional opinion or the scientific opinion behind this. I was going to say that cenotes are not impacted by sargassum but actually they are, right? and we will hear today why there's a connection between them and the sargassum. Yes I would posit the idea that possibly the reason that there were so many people there, was a direct connection to the sargassum. They people couldn't go to the beach. Well we'll hear about that. They're certainly being affected there. So let me introduce our guests, before we blurt out all the things that they actually found in our pre-interview talk. Today we're going to talk with Courtney Gallaher which is a jointly appointed associate professor in the department of geographic and atmospheric science and also the center for for the study of women gender and sexuality at the Northern Illinois University. Her fields of study include women in science, sustainable agriculture and food systems and environmental management and sustainability. Our second guest is Emely Hernandez, a master's student at the geographic and atmospheric science department at Northern Illinois University and she researches how tourism impacts water quality in Quintana Roo in Mexico. She also does some work in the fields of environmental sustainability and is an advocate for advancing minorities in STEM. Welcome to the podcast Courtney and Emely. I'm really pleased to be here today, just to be invited to this group because somehow I feel like an outlier for some reason. I don't know why or maybe they just needed me here for the diversity you know. Anyways, we always start out with wanting to know a very specific thing. We're not really looking for a sciency answer here but maybe that's what you'll give us and that'll be fine too. bBut we'd like to know, and we're gonna start with emely, I'd like to know what sargassum means to you?

So that's a very interesting question. When you ask me what sargassum means to me, what I think you're asking me why it's important and why we're talking about it. Which I would say, it's as if you read the paper, sargassum has been getting worse and worse as time progresses. So there's been a couple years where it was like extremely bad and then the year of 2019, it was one of the worst they've ever had. So I think it's important to talk about Sargassum, specifically in the Caribbean, because so many places in the Caribbean depend on tourism. Sargassum is detrimental to tourism, as we have seen in many places. So to me sargassum is something that we need to address and talk about, specifically as climate change gets worse, because it will continue to get worse.

I'm just picking up on where Emely was. As you know sargassum is interesting to me, because we have a colleague that's Japanese that does research in the Quintana Roo area with us, and he he's constantly confronted by this idea of sargassum, because in his culture as in many cultures around the world seaweed is a very beneficial thing, right? like it's farmed for food. It's used for medicine and so forth. And yet here it has become this environmental problem, which has rippling social and economic implications too and so it's this interesting example to me of how

situational environmental problems can be, and also how the sargassum problem in the Caribbean, it's sort of this indicator species, or this indicator of these changing global environmental problems.

Probably somewhat related to climate change, global social and economic patterns that are shifting, likely related to changes in industrial agriculture and urbanization in various parts of the Caribbean, leading to nutrient runoff and so it's, you don't want to say it's a cool problem, because it's causing all sorts of detrimental effects. but it's an interesting problem in that pulling it apart and teasing apart why it's there and the implications are complex.

Very nice thank you so much.

Robby and I in the pre-talk already talked a bit about how we think that tourism reacts in quintana roo to sargassum. but you actually studied this and did some surveys and figured it out and really got better data than what we have. So can you tell us how do tourists in quintana roo react when there's sargassum on the beach ? I guess. I can start first, if that's okay Courtney. So obviously, i'm not sure if you all read the article but in the article, obviously we were working down there, and we said that during the specific season of 2019 people were canceling the reservations, if they weren't in the region yet. If they hadn't traveled to mexico yet, they were canceling their reservations. Posting, sharing photos on social media about the seaweed, that's Sargassum. like telling people don't go here, you're just going to like encounter bad smells and a beach full of seaweed right now. Those that were already in mexico and they were already in the region and they found themselves with a beach full of seaweed sargassum, they were deciding to spend less time at the beach. So from the article, if you read it again, we found that 59% of local residents were spending less time at the beach and 47% of tourists were spending less time at the beach because of the seaweed problem. So then we saw, well they're not spending time at the beach, where are they gonna go since they're already there. Like what else are they doing ? That's when we asked the question where are you guys going instead of the beach? where are you spending your time instead of the beach and obviously cenotes was the number one option for both locals and tourists. I have some of the statistics here, 56% of tourists were choosing to go to cenotes instead of the beach because of the sea weed. Interesting and and can I ask you for for our listeners that maybe don't know uh what cenotes are. can you explain to us what cenotes are and how they're formed and why are they so attractive for for tourists? of course! Courtney knows a little more about it. Sure, the entire yucatan peninsula is built on what's called karst geology, so it's carbonate limestone and carbonate is affected by carbonic acid which forms when rainwater interacts with CO_2 in the atmosphere. It forms carbonic acid, it can dissolve the limestone and it creates all these really cool features like cave systems which are found throughout the entire yucatan peninsula. A collapse of a cave system it will open up the ceiling and create these open holes which create these tourist cenotes. The water that is found inside these cenotes, that look like giant swimming pools, is really the groundwater that people are swimming in. So it is the same water system that people are pulling their drinking water out of that is being pumped and well filled and sent to you know the major cities in the yucatan peninsula. But because they do provide these freshwater resources, they are used not just for domestic uses but for tourism. Cenotes are kind of unique to this region. You do find them anywhere there's carbonate limestone, but there's a huge collection of cenotes in this region, partially just because of the geology, and partially because of this massive impact crater from, um oh shoot maybe you guys can help me with the name of the meteor

that hit the yucatan, and is sort of tied to the extinction of the dinosaurs, all those millions of years ago. If you map out the cenotes in the yucatan you can see that it forms this ring and that's because it caused such friction and fractures and the karst rock, the geology there, that over time that is preferentially kind of where erosion happened and why we have all of these cool cenotes in the area. Cenotes have now become a pretty massive part of the tourism industry. Wow, I didn't know that but I remember from diving in the cenote, and correct me if i'm wrong, that you also have a layer of salt water below them, coming from the ocean. It's a very strong line in between the fresh water and the salt water. Exactly so the closer you are to the coast, the more sort of salt water intrusion you get. so that you'll have a lens of salt water sitting underneath the lens of fresh water. As you move inward that goes deeper and deeper and so depending on where you're swimming you can hit that sort of saltwater incline.

The research project that Emely was referring to in the paper, we conducted in 2019 with this fabulous group of undergraduate research students that we recruited from around the united states, to go down and do research on the impact of tourism on water quality specifically. So this sort of tourism cenote connection was a really obvious choice for us to study, and we did surveys and interviews and we're looking at policies as well as trying to understand the impact of tourism on water quality. and it was very interesting how this project came to be, because we were thinking about what are we gonna do because we had to come up with the research project. I didn't know what I'm gonna do but once we got there, we saw how bad this problem. We kind of turn our heads towards the seaweed problem, because once you're there, once you're by the beach, you just notice it so quickly: The smell, you can see it in the water. So it kind of just like came out of nowhere, because we saw it and then we kind of started digging more and more into it. What we're interested in, at this point, that some of these the cenotes are being more heavily impacted than they ever have been before, as a result of sargassum and all this increased anthropogenic interaction with the cenotes. That was kind of things that we're learning from this. So anytime people go into an environment, there are obviously anthropogenic impacts, but some of the concerns that we have about cenotes specifically, have to do with the fact that when people are swimming in cenotes they are literally swimming in people's groundwater, which then becomes their drinking water supply and so forth. We have colleagues who are water geochemists, who have done water testing in the cenotes in the region and have been able to identify all sorts of anthropogenic identifiers: presence of sunscreen compounds, antibiotics, illegal and legal drugs, fertilizer runoff, all of that has been identified in these cenotes at different quantities in different locations. How do they get ther? Well things like antibiotics and drugs, it's often people urinating in cenotes. While they're swimming, sunscreen is run off from people's body. Most cenotes do in fact request that the clients don't wear sunscreen or shower off before they get into it. Of course if they're showering that water is just going into the groundwater right, so it's all the same system. But we also observed during our research period tourists talking about how they just put sunscreen on the bus so that the tour operators would not notice that they were wearing sunscreen. So the point being that these chemicals make their way into the cenotes, and they change the ecology of the cenotes. So there's concerns about contamination from a human perspective, if the people are consuming the groundwater for drinking water or using it for bathing and so forth. But there's also implications for the ecology, these were previously fairly pristine ecosystems and anytime you introduce a change in terms of nutrient

composition or presence of chemicals, it has the potential to change these ecosystems really long term. The sunscreen in particular, is an issue not just in ocean ecosystems where we're concerned about degradation of the coral reef systems. The whole point of sunscreen is to block the light, so all of those particles when they get into the water block the light. If you're looking at an open cenote ecosystem where there's a certain amount of light that comes in and feeds algae or plant life or other aquatic biota and now you've got something that blocks the light in there, it changes what can live and what can grow and you will often get the presence of more harmful things.

Let me follow up a little bit on that. Sound like you have a problem with emerging contaminants to me. Which is, I think, we run into just about everywhere these days. I know you're focused on cenotes but they're you know certainly septic systems in the area or have you been testing any wells in the area to see what you're finding in wells close by or you're just looking at cenotes? We have not, but our colleagues, who are part of this broader research experience for undergraduate program that Emely started out as an undergraduate student with me on, and is now a master's student. It's funded through the national science foundation. We have some colleagues and their research assistants that have been testing well water and they certainly have found some of these chemicals in the drinking water systems as well. And there's a paper out that talks about that if you're interested. We can send you the link, please do! Yes, I have seen a documentary that shows how not treating the domestic wastewater well having chess pits here is also impacting the groundwater. The same groundwater that the cenotes are connected to, and seeing videos of what those underwater rivers look like below playa del carmen and tulum, it is disgusting full of plastic, brown color. yeah it's it's really bad.

We have some colleagues this year, that are starting to look at microplastics in the groundwater and then separately looking at the leachate from the sargassum landfills for lack of a better word. So you know along the beach they now have these systems for collecting the sargassum. Sometimes they have booms out in the ocean, sometimes they just scoop it up off the beach, but when they take it somewhere often times that is not a formal landfill, it's just a field that they have designated to be a landfill. As that decomposes there's all this leachate coming off. a lot of it is biomatter but as i'm sure you know Sargassum is particularly good at accumulation other types of toxic chemicals and so there's some concerns too. How that might impact groundwater systems? I've heard that some places where they have those landfills, that they have a liner below so that there can't be any or less leakage but I'm sure some of them don't have that, so if any of our listeners are in charge of one of these dumping grounds of sargassum on land, make sure you put a liner below it because it really makes a difference for safeguarding your soils and your groundwater and all that stuff. It's really important and hopefully at least in quintana roo there's more and more companies who are using sargassum to make products, so hopefully at one point in the future we won't actually have a lot of it going into those landfill or dump sites and actually will be used as a resource.

so we already talked a bit about why it's important to protect the water quality of the cenotes. Do you think it's that it has a really big impact on the groundwater if more people go to the cenote or is it probably a bit minor? I can talk a little bit about this one, so since this podcast is about sargassum um I feel like there is indirect impacts from sargassum to the cenotes. Obviously they're not like directly linked but they're indirectly linked if that makes sense, Sargassum was pushing people towards the cenotes, and now more people are swimming in the cenotes. So now the question is: are there any environmental regulations or any policy that can mitigate those changes that are coming because they are already happening so how can it be mitigated?

let's see, so in the paper we studied the three different states, Yucatan, Quintana roo and Campeche, and we compared the regulations that are already in place. We found that there is little to no regulations at all. Indeed, Yucatan was the one that had the most regulations, but they weren't as rigorous as they should be. But courtney can talk more about that, because I know she analyzed it a little more than me. First just to the question of whether having tourists in cenotes impacts groundwater quality, ground water flow not totally lateral, like it's going to stay concentrated a little bit. So part of it is the question of whether people living in and around the cenotes. whether they're drawing drinking water and so forth are going to be impacted by tourism, maybe is the data that our colleagues are finding. But I think bigger picture there's also this issue this is a really fragile groundwater dependent ecosystem. If we're interested in environmental conservation, then we need to think about these issues of regulation and tourist carrying capacities and so forth. These regulations are lacking at this point in time. The regulations do vary by state and municipality, but very few put tourist carrying capacities from an ecological standpoint. So I was interested in your story, where you said that you went, I think I know which cenote you went to, and tried to enter and it was full. I assume that actually has more to do with staffing issues than just sort of management of the cenote, and less to do with ecological concerns, would be my guess. If it is ecological concerns, then it was the initiative of the owner. It probably wasn't ecological concerns, but because we have the COVID-19 crisis still and we are in the orange phase, so most tourist places are only allowed 30 or 50 capacity loads that they can have. So each place, whether it's a shop or cenote, has a certain amount of people that can go there, because of COVID-19, so maybe that is actually helping the cenotes and giving some regulations on there that aren't due to protecting the environment but will still help to do so.

One of the things, we're waiting for our colleague to analyze this data, but when everything sort of shut down at the start of the pandemic, our colleague started going out to the field once a month and collecting water from all the different cenotes that are on their list and some of the well fields. We have data points every month since the start of the pandemic to kind of see what happened with groundwater contamination falling. We're excited we're waiting for all those results and I'm excited to see kind of how that pans out. So I want to ask a question related to that, because we've been talking about the indirect effects of sargassum, so the tourist going more to the cenotes and the people contaminating the the cenotes themselves. but also we have the direct impact of sargassum through this groundwater leakage of these brown waters and the contamination from the landfills and so, which one

is most important, because of course if we start restricting people from going to the cenotes or like now with COVID-19 have a limited number, that's of course gonna do us a favor. But is this the relevant part or should we be actually tackling the sargassum part, because that's the one that is worse than the humans being there or are they equal? I don't know the answer to that question, to be honest, but my educated guess is that it depends on the geography of a cenote so if you're very close to one of these areas where you're getting significant groundwater contamination say from leakage from a landfill site, then that might be a significant contributing factor, but that if you're further inland, my best guesses the tourism, people directly swimming in the cenote, that is being that part of the tourism industry is contributing to it more directly. So I don't know that answer. It is to say, we shouldn't say not to have tours of cenotes. It's a really important part of the local economy, but it is a thing that needs to be considered thoughtfully. Thoughtfully means that we have specific management strategies in place. Right now it is more of a free-for-all. Things like establishing ecologically based carrying capacities where we know if we have x number of tourists in, that it can sort of bounce back. You know it's like diluting the pollution that goes into the groundwater. Just better, I don't want to say education, but better enforcement of concern of you know sunscreen application, that sort of stuff going into the cenotes would be helpful. Yeah, I like that you make that difference like you were gonna say education and then you were like no enforcement actually. I'm very hesitant to say that environmental education will solve any of our present problems. People need to understand a problem, but I think that this past year and a half has taught us globally that people don't always make informed decisions.

Exactly, I fully agree with you and so my question is now moving towards the more positive side of things, so which solutions do you think we should implement besides the management. Are there any other ideas out there on how to solve this issue? Do you have anything that you'd like to share? I guess you can go first. I hate to harp on this idea of regulation and management, but this is the way that we have seen with many environmental problems globally successful intervention. When there's a problem right, as soon as you choose to measure and regulate, it's showing your priority towards maintaining an environmental resource. You know in the United States when we put certain legal protections around things, then you have recourse for action, when that is not followed. Having some sort of legal frameworks that's the priority and the goal of maintaining the ecological integrity of these pilots and so again

tourism is vital to this region, so the answer is not no tourists in cenotes. It's how do we do this in a way that chooses to maintain some level of ecological integrity while still allows people to enjoy the cenotes and right now that just really hasn't been happening. The other concern that I would say has to do with sort of just regional management strategies, is that a lot of these cenotes are being developed in a way that is causing not a land rush, but people are buying up land to access cenotes because you can't purchase water, but you can purchase the land that the water is on. So it's it is causing some tensions in the region around indigenous land holdership and sort of who gets access to land. Cenote owners are deeply protective of their properties and knowledge about how many tourists are coming in their business operations. Understandably, like it's a competitive economic environment, but that does make it challenging to make good regulatory decisions without the the municipality or the state saying this is a priority for us. I'm gonna get a little bit sidetracked here, but I just want to mention that the first time I

went to Mexico the owner of the Airbnb where I was staying was a cenote hunter and his task was actually to send some locals out in the jungle to find cenotes that hadn't been found before and then buy that land for a very cheap price to then sell it to foreign people so that they would own a piece of pristine water and this is exactly what you're talking about right now. Like this is actually happening and this is terrifying to be honest. Yeah and you know I think that much like you see in all areas of the world, this creates this intense tension between the tourist economy and local indigenous rights and local indigenous economies. Unplanned development often leads to exacerbation of social inequalities and so there needs to be more thoughtful planning.

Very nice. I was very pleased to read in your bio that you're both interested in minority STEM education and women being in STEM education. I'm working with every seafaring linguistic group from the western Caribbean from Campeche to Puerto Limón in Costa Rica. We've been developing methods to seamlessly combine indigenous ecological knowledge systems with western science to create this next level biocultural STEM curriculum in local languages, to be used in these schools. So I'm really pleased about that, but what I'd like to hear for our audience but for this question, your answer specifically to me as well. What are your recommendations for getting more women and minorities into universities and into the science field? Because that's one of the goals that we hope will be a spin off of what we're doing. I think these indigenous peoples being the resource managers is an awesome idea. Do you have any suggestions for me personally and for our audience about how to encourage that kind of stuff? I'm going to let Emely go first, because I could talk about this for like four hours.

Actually when I saw the question on the document, I was like, wait this is one of the hardest questions out of the whole document. Just because when I think about that, I always think of my story, you know as a woman of color in STEM and just how I became interested in STEM growing up. I was always interested in like the sciences and like math. It just got my attention so much it, I don't know it just came naturally to me right. When I went to college, I knew I wanted to do either science or math just because I've always been attracted to it and then being in college, I found out that minorities aren't represented as much in STEM, so I think that was, I know it sounds weird to say it, but it was more like a push to go even further if that makes sense, knowing that there aren't that many minorities in STEM. When I did the REU program, the research experience for undergraduates, I feel like it opened up a whole new door for me. It opened up research experience, it opened up conference, I went to conferences, like a research conference, you know it opened up contacts, networking and then graduate school. Graduate school had always been in the back of my mind but I never thought I was going to go just because I never knew much about it. But when I did this program, it like opened my eyes to how accessible graduate school can be, especially being low income and being a first gen, like there's a lot of people who will help you out. I was lucky enough to work with Courtney in the summer of 2019 and I really really enjoyed working with her and I mentioned to her that this would actually be like really cool to follow and research, like jokingly right joking. It was like this would be really cool work to do as like a master thesis or something and then she said if you come here, we can keep working like down in Mexico and this could be your thesis. Then I said: wait what? so then the mentors informed me how graduate school is

accessible, because they can pay for your studies and they can also give you like assistantships and all of that. So definitely, programs like the one I did were super helpful for me, and I can speak also for my colleagues who I was doing the program with, there were six of us and three of us are now in graduate school and then all of all six of us were not thinking of graduate school. We didn't think it was an option, but now 50% of us are now in graduate school. I think programs like that really changed my life and as well as the mentors who I was lucky enough to know and work with my mentor. I have experience with her, so I know that I could work with her in a master's. So definitely people that do not understand you but want to see you succeed and they want to be there to help you to like lift you. You know this is a hard question as well, because as minorities women of color, the system is kind of against you. Specifically fields like geography, it's very white male dominated so it can be really hard, it can be really easy to get lost and just feel like you don't belong there. But just know that you do belong there that you're there for a reason and there are people that will help you and lift you up, whenever you need to like Courtney. I'm really grateful that she's my mentor. But, yes, I can talk about this all day. Well, I think Emily is one of these success stories in my mind because the mentor mentee relationship is one of the things that we know from research it gets women and minorities into STEM and keeps women and minorities in STEM. But as Emily alluded to one of the really big challenges is this feeling of not belonging, and this feeling that you as an individual need to just sort of power through and prove something. Some former colleagues and I did a research study looking at these push pull factors and what factors are getting students into undergraduate STEM fields. What we found was that a lot of people were conceptualizing this as individual problem and so they were being told: you know there's STEM Barbie, like you know scientists barbie dolls, and there's like all these STEM camps for girls. It's giving people the idea that if they just emulate this behavior and they do this thing and they work really really hard and power through it they'll be successful in stuff, and that's true to a certain degree until they hit these institutional roadblocks. So this ultimately is a structural problem where we need better training for people who are in STEM already and better formalized opportunities for women and minorities to be successful in STEM. So I think that the research experience for undergraduates program through the national science foundation that Emily was part of is a really good example of these more formalized programs, where students are given a paid opportunity to spend the summer working with research mentors and to really be exposed to it. The first time I mentioned graduate school, Emily, she said I could never do graduate school, people like me don't do graduate school. You know, this is the thing, I hear a lot from students and it's easy to see why students feel that way, if they don't see themselves represented in STEM. So this is a problem that goes all the way from the bottom to the top of the field, at academic universities, at private industry and changing it will require more than just willpower on the part of women and people of color. It requires creating structural changes, that create welcoming environments and create opportunities for advancement that are fair.

One of the challenges that we, or one of the things that we identified in this project that we did before, that we called feminism for women and stem, was that when girls, when women were going off to college and saying I want to be an engineer, I want to be a biologist or whatever and then doing everything that they felt was right, and still hitting these barriers, that were sometimes quite unfair and based on their gender, they felt like they personally had failed. So you can't just muscle your way through

it, if your professor, for example, is treating you differently than your male colleagues or if the review process is biased against you. So yeah we need change from the top to the bottom and the bottom to the top, but the mentorship I think does play a really key role in providing not just mentorship, but really hands-on opportunities to engage women and young girls and some at young ages, that they can say this is a thing that girls do, or this is a thing that people of color do, and can do quite well so yeah definitely I fully feel you. As a young scientist still, with a small kid, I can tell you that the invisible ceiling, the glass ceiling, is reached before you think about it, and then you realize: hey but they promised me that things were changing and then we're not really changing as fast as they should. I fully agree that having role models in science that they can look up to and say okay we can also do it because there are people already up there doing it, that would definitely have helped things. I don't know if you've heard the analogy of the leaky pipeline that gets used a lot in STEM but it's the idea that we often get a lot of young girls that are interested in STEM fields and as you go through you sort of leak them out of the pipeline and so you lose a certain percentage going off to college and another percentage after the bachelors, by the time you get to the phd there's like very few women graduating and same for people of color. Then you see that same process at least at academic institutions between incoming assistant professorship and full professorship and that is certainly not because women or people of color are less good at science, it has to do with all these institutional barriers that they encounter, that glass ceiling that you run up against. Exactly! Thank you both of you for this really amazing interview, I learned a lot I guess our listeners also learned a lot. I hope that in the future when we continue doing research in Mexico and these areas we see an improvement thanks to your work that there are more regulations put in place and that cenotes are protected, and they keep on being the treasure they are. Good luck with all your all your projects, and Emely go for it! you can do it! I'm an assistant professor. Thank you so much, thank you so much for having us today this is really wonderful to be part of this. Thank you so much for being here. Bye guys, thank you so much. Thank you, bye. That was a pretty good interview today. Those are some really nice people, we got representatives from Guatemala and here in the states and I just thoroughly enjoyed myself as always. But so Franziska what was your take home message today?

My big take-home message, which made me really happy is that they said that they are working on a study that looks at the impacts of when the tourism and also locals going to cenotes was very low or non-existing due to COVID-19 and then as people are coming back with regulations being lifted what is happening to the cenotes. Because together with other colleagues I'm working on a study, not personally, but other colleagues are doing the field work, to do this for coral reefs and COVID-19. It is really an experiment that we have around the world, where we can really find out the carrying capacity of tourism and the impacts of tourism and I'm really happy that they're using this opportunity as well. It will hopefully help them get those policies in place that they want to put in place. The other thing, I was thinking during the interview, we talked about the sargassum being stored in places, in those landfills, maybe there should be regulations on how far away those can be from cenotes. Those landfills shouldn't be really close to cenotes or in places where the groundwater flows towards the cenote because as they said, in the cenote itself it's a really really cool ecosystem, I always bring my mask and snorkel because there's all these algae and plants and fish and everything in there. One of them apparently even has an

alligator in it. I didn't see it but apparently it's there. So yeah you want to protect those species as well and the ecosystem, to have the beauty of the cenote that the tourists go for and the locals as well.

yeah I thought it was actually super interesting how this COVID-19 pandemic will actually enable them to answer that question that they couldn't answer today, which is what is worse the the tourists or the sargassum because during COVID-19 you still had sargassum but you had almost no tourists so they would actually be able to see that difference. I fully agree with you that putting in place stricter regulations not only for the tourism which i guess it's relatively easy to do, you know to put some quotas to access the cenotes and so on. But to then claim okay the sargassum is really so bad when it leaks to the ground water, that we really need to solve that part as well and then we put pressure also on this landfill issue to either remove them or make them safe or you know just do don't bring the sargassum to the landfill. It's bad for the climate, it's bad for the ground water, is bad for everything so it's just another point of view that we hadn't touched until now and I thought it was very interesting.

Well, the thing about that leaking, you know we're mostly talking about the yucatan today but you know all this water in the yucatan sits on that lens. It's a lens of fresh water on top of salt water and it's the same on islands. So this research is going to have a lot of applications for the island nations of the caribbean that have been affected by this parking of Sargassum and stuff percolating through so that's it's really important stuff they're doing. well it was it was very nice to see that a young woman that thought that she could never ever do research, has found a cool mentor and it's actually doing really cool work so that was very inspiring to me. Yes, that was inspiring for me too and I have sent so many letters for my past students who want to apply to those RUI projects and to internships and they need letters of recommendation. So hearing that these programs really can change somebody's course and that 50% of the students in the project actually went to graduate school afterwards, makes me really motivated to write those letters. To take the time to do that and help them out. Actually yeah this has been a really good day and on so many levels, both academically and and it's been good for my heart as well make me feel real good. It's always good to be inspired by young people but that being said we're going to call it a day here. You could have been anywhere on the planet with us today, but you chose to be here with us, we really appreciate it. This particular episode is being brought to you by seafields and they're doing some really good work out there and i hope you'll check them out and see what's going on and with that have you a good time and we'll see you here next week.

See you next week. bye everyone.

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