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Nancy (0:00): Hello and welcome back to Carry the One Radio! My name is Nancy and I am one of the producers here. I can't believe this is already the 15th episode of our Young Scientist Spotlight series! We've spoken to so many interesting graduate students, postdocs, staff researchers and other early-career scientists.

Today, you'll hear from my conversation with Gaby Keeler-May. She's a graduate student from the future! Just kidding. Well, she *is* in New Zealand, though, so by the time we were talking, she was actually already one day ahead!

We talked about how an interesting course in scientific diving led to her current PhD. And we also discussed some of the invasive species of seaweed in New Zealand as well as how we can make use of them. And finally, Gaby talked a little bit about being a PhD student who has already had many years of work experience.

I hope you stay tuned and enjoy this conversation as much as I did.

[CTOR Intro]

Nancy (1:10): I was so excited to hear about Gaby's story that I actually forgot to have her introduce herself, so I'll introduce her for you. Gaby Keeler-May is currently a second year PhD student studying Marine Science at the University of Otago in New Zealand. She is looking at the ecological impacts of the invasive seaweed *Undaria pinnatifida*, also known as wakame.

Gaby grew up in Colorado but her PhD led her to New Zealand. I'll let her share the rest...

Gaby (1:41): When you think about it, like Colorado's landlocked, right. And so it seems strange that, I dunno, someone like me would study Marine science maybe. But you're just like, "oh, just go West...And I actually went to school in California when I went to university. And so I studied at UC Santa Cruz.

Yeah. So I was there and I actually joined the scuba diving club when I was at uni. And so that's what really kickstarted everything for me, I guess, into marine science. And even though growing up in Colorado, we didn't have the ocean, all of my science classes, there were... they're kind of what inspired me. I had a teacher who'd take us out to the rivers and we'd go like sample little invertebrates and look at water quality things. And so I guess I could have been a freshwater ecologist, too. But instead, when I just went to university and discovered this whole world of scuba diving and marine science, it was really my thing. I got quite excited about it.

Nancy (2:42): Oh interesting, so it was actually scuba diving that led you to marine science.

Gaby (2:46): Yeah. The scuba diving program in Santa Cruz is really popular. I think it probably still is. But when, when I first started my first year, we... all the students that want to like try out

for the course, you have to pass the swimming test. And they can only take on, I think, 20 students or something just 'cause your diving instructor can't be in charge of too many people, you know, 'cause they have to watch you underwater.

And...yeah, I joined it, passed the swimming test and then got really lucky that I was raffled into the first class. And that kickstarted this whole exciting path of just being underwater and having fun with these new people. And I was, I don't know if it's the same for everyone when they first start university, it's kind of overwhelming and you're in a new place...And so just like having that club of people and a bunch of scuba divers was really exciting.

And then I started learning from some of the older club members like, "oh, you can scuba dive for science, too." And there's these scientific diving courses and you can learn how to do that and how to learn to do all the things that scientists do, but underwater. So I was like, "oh, that's so cool." And so, yeah, I kind of started, I guess, in over pretty much all of my four years at uni, just building up the qualifications to take that scientific diving course 'cause you get credit for it. And there's the prerequisites for diving to learn that and do that until you can get into that scientific diving course. And so then I did that and just learned all about scientific diving.

Nancy (4:33): Haha, it's great that you were so determined! Can you tell me a little bit more of what that means to do scientific diving and also, what kind of lifestyle is it to be a diver, or a scientific diver?

Gaby (4:46): Yeah. That's funny that it's a "lifestyle." I guess it kind of is. So, scientific diving is different from recreational diving a bit. I guess it still involves all the same. You need to understand how to be a recreational diver first and be safe under water. And especially...I learned to dive in Monterey and even here at diving in New Zealand, it's all cold water. So understanding how to take care of yourself; if you're too cold, get out of the water. Or if, you know, the ocean currents are really strong, not getting in. So, there's all kinds of that that you take into account.

And when you learn about scientific diving, it's kind of that, and then amplified because you learn about how to take all of your research questions and bring it...to figure out how to do it underwater. And so you kind of...it's like you kind of limit yourself, right? 'Cause you have this question done, but then you only have this certain amount of air to like go underwater and survey it or collect the samples or whatever you're collecting. So it involves a lot of planning and just making sure you have the right tools. And you know, sometimes maybe if you forget something or you have to maybe figure out a different way. 'Cause you're like, "oh, I'm already under water, my boat's far away. I'll just... I'll either figure it out or maybe I just can't do that part of this survey at this time."

And so it's like adding that on to all of the regular parts of scuba diving, like also being safe, checking on your buddy, making sure everything's okay. And so when you take your scientific diving course, you learn how to do that and then you just practice it over and over and over again until you're somewhat comfortable.

And so I guess for me now as a PhD student, I kind of do that and get to lead groups into doing that. And so it's really scary 'cause I'm still a student, but also getting to work on my research and my research questions. And a lot of other people are helping me do that.

[music]

Nancy (6:58): So, can you also tell me, what are some of the tools you have to prepare when going underwater? I'm sure you have to get creative, too.

Gaby (7:05): Yeah. So it's not like...at least the work I'm doing now isn't... it's not like I'm using any power tools or anything under water. I know people who, maybe for some of their experiments, are using power- ...like underwater drills. I'll just use pretty simple, straightforward tools. I have to set up some transects that are permanent and I'll just have my hammer and my stake that I'm putting in and some concrete, like underwater concrete that I can mix up and have prepared. And so just bringing all of that. But like a lot of times it's just bringing my transect tape and measuring out the distance of what I need to survey. And like a quadrat to look at these certain areas or count certain things.

Nancy (7:50): Wait, did you say "transect tape"? What is that?

Gaby (7:54): Yeah! Oh, it's like, it's like big measuring tape. Okay.

Nancy (7:56): Oh! That makes sense. So, how long are you underwater at a time?

Gaby (8:02): Um, so the dives that I'm doing right now, they're pretty shallow-ish. I guess like four meters. So it's probably, I don't know, that's maybe like 15, 16 [feet]...I do everything in meters now, so it's like five, four or five meters.

Nancy (8:20): It's okay! The rest of the world uses meters, so it's totally fine.

Gaby (8:24): Yeah, okay cool. I was like "it's like 5, 4-5 meters." So we can actually be...I guess it depends on the person and the project and what you're doing... and staying within your dive tables, too, 'cause you can't be underwater for too long because you get—that's part of the physiology of diving that we learn about when you take dive classes—the nitrogen buildup. And you can't stay there for too long cause that's not going to be good for your body. But yeah, usually I think my dives will usually last about an hour. That's what we plan for. Sometimes they're a little less.

Nancy (9:01): Once you're underwater and all set up, what happens next?

Gaby (9:04): So when we do my collections, I plot out these really big areas. And so we're doing 50 meter by 20 meter areas that are about, I think it's like two to three meter depth, average.

And so going in there, within my plots, and just pulling out all the invasive seaweeds. So we did that over a couple of days and ended up pulling out 12 tons of seaweed! That was just like... there's so much of it. And it was over-... So, what is that? 12,000 kilograms I think. And it was over 5,000 meters squared... these five plots each a thousand meter squared. We didn't even realize that's how much of it was there. And that's just small areas. The whole coastline that we're looking at is 22 kilometers.

Nancy (9:52): Oh my gosh, that sounds like a LOT of seaweed. So, how do you actually get the seaweed out of the water?

Gaby (9:58): So there's a student, there's a master student here before who started looking at different ways that we could do that. He had set up these nets that we could put everything in and the divers or the snorkelers would just put all the seaweed in.

So it gets pretty big. When it's (the seaweed is) an adult, it can be like one to two meters long. And so it comes off the rock pretty easily. If you'd need a little knife, you can kind of cut it off the rock, but we try to take the whole thing out. 'Cause if you leave any of the parts behind, it may still be a bit disruptive to the environment.

And so we'll pull out the whole part and if there's any other things, sometimes little things that'll hold fast—like a little, I don't know. I don't really know what I'm describing—but it can house its own little community. And so trying to make sure we leave what we can behind and only take out the invader. Just pulling it out, putting it in these big nuts and then taking... then we have a little boat that's up next to us and then just giving that to the boat. Then they'll take that and contain it in something so that we can take it back to the port and crane it off the boat.

And so most of it we're just able to compost—we have a big area that can just go into compost. We're also trying to figure out other ways that it could be utilized, but that's a bit outside of my project. *Undaria* is wakame, it's an edible seaweed. And so to make this a system where we could take this invasive out of the water and potentially utilize it in other ways, there's potential for that there, too.

Nancy (11:38): Interesting, so the *Undaria* or wakame can be collected and turned into food. That's like hitting two birds with one stone. You get rid of an invasive species while being able to manufacture a food product. But it sounds like you would need a lot more people to assist in the process, right?

Gaby (11:54): There's work. You can be in the water doing things, but we always have people on the boat helping, captains driving the boat, and the people who are operating the cranes to move the seaweed. And even on the land side of it, too, like processing the seaweed. If it's food, you know, you need it to be food grade. I don't really even know what all the other components of that are. Then that could spread on to the people who cook that food or make that food. There's also...beside it just being food for human consumption...it can be an additive to animal feed and agriculture or even fertilizer, too. The soil in New Zealand, I think, is lacking in

nutrients. And so adding seaweed is actually a really good additive for the soil here. I think there's a lot of potential for it. It's exciting to be on the ground floor and wondering what it could turn into.

Nancy (12:55): Yeah, it sounds like there are so many different kinds of uses for seaweed. So, what in your studies so far, in your work with seaweed, what have you found to be the most fascinating facts?

Gaby (13:07): [chuckle] Well, I guess just overall I think seaweeds are really cool. There's other people in our department that do really amazing things with antibiotic science or like marine mammals. Those are all really cool, but I definitely have an affinity for seaweed. And I think part of that is just that they're the foundation of the whole food web and complex systems. And they do the same thing that plants do on land: they take in that carbon dioxide and then get us the oxygen to breathe and like put it in the water for all the animals. And so they're like really the building blocks and foundation of all of that. And that in itself, the whole big picture, is very interesting for me.

And they're just so pretty. Anytime I go on a scuba dive, I'm like, "what are all these seaweeds?" I love cold water diving because the seaweed is very diverse here. When you go tropical diving, it's amazing and really colorful and there's lots of fish, but there's not any seaweed. There are some, but it's not as big.

Nancy (14:12): So what are the different types of seaweeds?

Gaby (14:16): There're big groups of brown seaweeds, red seaweeds, and green seaweeds. I don't actually know exactly how many there are. I know that the red seaweeds are very diverse and there are seaweed researchers here and taxonomists who are still collecting seaweeds and learning about these new seaweeds like in the waters here. 'Cause I guess it's logistically kind of hard to collect some of these seaweeds and new things, so you'll find these new things in their water.

Nancy (14:46): What are the differences between the brown, red and green seaweeds?

Gaby (14:50): Outside of the color, the brown seaweeds are generally very big. It's the one that a lot of times you'll see in California. It's the big *Macrocystis* ones. They are the big canopy forming ones and then there can also be lower level canopy ones.

Then the red ones are the ones that I know of and I've seen. They can be really branched and pretty and lacy looking. But there's also some reds that can get quite big as well. So they're quite a diverse group of seaweeds.

Then the green ones... The most common one is probably the sea lettuce that you can see in the intertidal and the shore. It's in San Francisco. I remember seeing it in the harbors there.

They kind of all work together. I guess when you're thinking about a forest, the brown kelps are kind of like the big trees and then there's all these other complex little things in the understory that are around them that kind of just add into the whole system and fill the space.

Nancy (16:00): So what are you hoping to learn from your seaweed research? What is your research question?

Gaby (16:04): My question, before I started and was planning it, was that I wanted to understand the impacts of *Undaria*, which is this invasive brown seaweed that's here. And it's originally from Japan, but it's been here for about 30 years now. And my current supervisor has done surveys and there's been some surveys that have continued since he started those in early 2000 to measure the density of it and like how much of it is here.

Seeing the impacts and what it's actually doing takes such a long time to see. When something shows up, it may not be doing anything right away. And so a lot of what my question is, well, how can we measure that? Because when we look at the density, we can also look at the way that this invasive seaweed grows. It's an annual (plant), so it grows really quickly. And so we know it's biomass is really quite large. And so I've been working on a way to figure out how can we measure that? And how can that help us understand what it's actually doing to the underwater environment here?

[music]

Nancy (17:21): We talked a lot about scuba diving and seaweeds, but now I want to circle back to your path to your PhD. Can you share a bit more about your decision to pursue a graduate degree?

Gaby (17:33): Yeah! I actually took a couple years off between my undergraduate and before coming here. So, I was in Santa Barbara for a little while working with a nonprofit there. We were looking at seabird habitat restoration. And so I guess what got me a bit into invasive species and restoration is that project, but it was like vegetative restoration. And so we were on land replanting the native shrubs. These little seabirds, they spent all their life at sea and then they come back to this island to have their nest in these shrubs, but those shrubs weren't there for them anymore, so their populations have declined. And so I did that for a couple of years with a group off of Ventura actually. And then after that, I was at UC Berkeley for a couple of years and I was helping in the instructional biology labs.

For a long time, I was like, "oh, I'm never going to go back to university." I was pretty good with my undergraduate degree and really happy with that. But then I was helping lots of students with that instructional biology lab and even working with lots of graduate students. And they're like, "oh, you're pretty good at all of this. You should really consider grad school. That gets quite fun." And I was like, "no, I don't really...that seems really hard. Like, who's going to pay me to go to grad school. I don't need to do that." And they're like, "no, no, you'll really like it. I can just

tell.” So, I had some people there... [So I was] like, “okay, yeah, maybe I should start looking into it.” And so just looking for programs...I knew I wanted to do a program internationally.

And I did something kind of silly where I looked at the distribution of the giant kelp—that's the *Macrocystis* kelp that's off the coast of California. And I was like, “where else does that grow?” It's all in Washington, so I could have gone to different places along the Pacific coast. The Southern hemisphere distribution was in Tasmania and in New Zealand. And I was like, “oh, I'll look at programs around there. It'd be cool to go dive in a kelp forest that's similar to California, but actually quite different.” And so that's what brought me to looking at the University of Otago here and then finding my supervisor and working with his whole group. ‘Cause he does most of the seaweed physiology and seaweed lab projects here.

Nancy (20:02): I'm glad you got to find an interesting advisor. So what happens after you find someone you want to work with?

Gaby (20:08): Yeah. Well, first I just, I sent an email out to my supervisor, Chris Hepburn, and I was just like, “hey, I like what you're doing. Are there any projects that I could work on? Here's my CV.” It's kind of awkward when you send out those emails, ‘cause you never know if anyone's going to reply back. I sent other ones out, too, and didn't get replies really from any other people. And, and then he was like, “oh yeah, like I'm quite busy right now, doing this teaching stuff, but get back to me around this time and we'll definitely talk about it. So I was like, “okay, cool.” And I put in my calendar to email him back at this time.

And so I did that and then he's like, “oh yeah, cool, let's have a Skype interview.” And so we just had a really informal conversation like this and he's like, “yeah, that's really cool, everything that you've been doing. I do have these projects in mind that maybe would be good for you. Let's continue having conversations about this and send me your proposal for what you think about this and what you could set up. And then we'll kind of go from there.”

And so it turned from that and submitting a more formal proposal and what I thought I wanted to do that would go in line with his idea of projects. And then he was like, “yeah, cool, submit your formal university application.” And you have to have your advisor supporting it. So he's like, “yep, they'll like send it to me and I'll approve it.” So yeah, that process was pretty straightforward but it was also very scary cause you're just online doing it. I'd never been to New Zealand. I couldn't pop into the international or, you know, the student office or whatever, and just be like, “hey, I want to apply here,” you know? I'm just having conversations on email or Skype.

And then eventually it was like, “okay, you're accepted.” The visa process took a little while, and just like sorting all that out.

Nancy (22:10): Yeah, visas are always a pain. So, how long did the entire process take?

Gaby (22:15): Um, I think it was probably, maybe eight or nine months. It was nearly a year, but not quite. I pushed it back a little bit 'cause I was like, "oh, I want to save a little bit more money and travel a little bit too before I actually come down there and do school." So I think I pushed it back maybe like three months. It could have been a little faster if I had wanted it to.

Nancy (22:38): Well, I'm glad you got to travel. That's always such a great thing to do if you have the opportunity. So, how did you feel coming back into university after working for a few years?

Gaby (22:49): The first few people I met had gone straight from undergrad into their Master's or PhD. And I was like, "oh, that's quite different from what I've done." And I [experienced] a bit of imposter syndrome. I was like, "oh, I did it wrong. I'm too old to be here." But then you meet other people who are the same age as you, or even older. And they're like, "oh no, that's totally fine. Everyone's story is different." And so it's nice to have those people who make you feel a bit more confident and know it's okay. What you're doing works.

It's definitely weird when you're like...I was actually working for five or six years and then decided to come back to university and some people are like, "oh yeah, I haven't left school yet." kind of feel bad for them sometimes, too. 'Cause they'll ask me about it. They're like, "oh yeah, maybe I should take a break. It sounds nice what you did." And I'm like, "yeah, well there's definitely that opportunity there." And school will be there when you want to come back to it.

Nancy (23:49): That is so true. And that is the whole point of our Young Scientist Spotlight Series. It's really to showcase the different paths into graduate school and into science.

Um, well, Gaby, that is all the time we have today. Thank you so much for taking the time to speak with me and I hope to see you in New Zealand someday. It sounds phenomenal.

Gaby (24:09): I know! Everyone should come to New Zealand. It's so good here!

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Nancy (24:21): This episode was produced by me, Nancy Cai, from my closet. Music is Palms Down by Blue Dot Sessions. The interview was originally conducted in August of 2020 and since, Gaby has been busy with fieldwork and had even organized an online conference. Great job and good luck with your studies, Gaby!

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