02/22/2024

BD049

**Interviewer 1:** So, just to get started we were hoping that you could tell us a little bit about your area of expertise and your research.

**BD049:** Sure! So broadly speaking, I study sediment dynamics. So I’m interested in how sediment gets from land into the adjacent water and how it interacts with plant communities like marshes, SAV, and how the sediment and plants interact to build elevation in marshes and/or affect habitat for SAV. And then I’ve been doing a lot of working thinking about human alterations of the shoreline, specifically a lot of work in living shorelines, which is where I interacted with Arianna the most.

**Interviewer 1:** Ok. Very cool. And is your research focused in the Chesapeake Bay, or all over? What is you system dynamics?

**BD049:** Um, I think all of my work is in Chesapeake Bay, that’s true. The sites that we’ve been working on for living shorelines are all in the meso-haline bay on the eastern shore. So Talbot and Dorchester Counties primarily. There’s one site up in Queen Anne’s County across the bay bridge.

**Interviewer 1:** So, like I said in the email to give you some project background, the really high level goal of this project is to understand the role of biodiversity in marine resource management. So understanding what the key aspects of biodiversity are for marine resource users, understanding what components of biodiversity regional managers think about when they make decision, and then understanding overall if and how biodiversity is a consideration in marine resource management. And so, obviously those questions are really high level and daunting, so to help answer those questions we’re doing three case studies to look at some more local socio-ecological dynamics. So we just did our first case study in the Gulf of Mexico, and then the Chesapeake Bay is our second case study. And then we’ll do a third one this fall in the Salish Sea. Which I saw that you did your pHd at University of Washington, is that correct?

**BD049:** Yeah!

**Interviewer 1:** So I might have to pick your brain at the end about Salish Sea, if you have any ideas about that if you have time.

**BD049:** Yeah, I’d be happy to go. For a visit and say hello.

**Interviewer 1:** [Interviewer 2] and I are trying to plan a summer trip to - well we’ll all be going, our team, in the fall, but [Interviewer 2] and I are thinking hmm is there any budget in the summer to go do some pre-workshop work? That would be lovely.

**BD049:** Yeah, for sure.

**Interviewer 1:** Ok, so to answer those questions, we’re using a tool called mental modeler. Are you familiar with that tool at all, have you heard of that?

**BD049:** Um, I’ve heard of mental models. And I’m not surprised that there’s a tool that does that. But I have not really used the tool or done a ton of work on it.

**Interviewer 1:** Yeah, so mental modeler’s a software, it’s open access if your interested, that one of our project collaborators Steven Gray developed with his research team. So I’m just going to go ahead and share my screen so you can see it. Can you see the mental modeler software there?

**BD049:** Sure can!

**Interviewer 1:** Ok, perfect. So yeah, it sounds like you might already know this, but as a quick overview, we use mental models as a way to capture how an individual thinks about a system or to capture their knowledge on certain socio-ecological system dynamics. So, what we can do is we can create a list of system components based on our research questions, and then we can draw out how those system components are related to one another. So, understanding if there are certain relationships, positive or negative, between different system components. And so what we’re hoping to do is to today capture your knowledge and perceptions around biodiversity in the Chesapeake Bay. And to do that we’re hoping to build a mental model with you, if that sounds good to you.

**BD049:** Ok, sure. I don’t know a ton about biodiversity, so maybe it’ll be a small…

**Interviewer 1:** Well so - and that being said, we also want this to represent your expertise. So we’re going to ask high level questions about biodiversity, but as you’re talking about your area of expertise in the Chesapeake Bay we can add some components related to your specific knowledge as well. That’s still helpful.

**BD049:** Alright. That’s all good. I guess I was just setting expectations for you.

**Interviewer 1:** Yeah, no it’s great. We appreciate it. So, just to start. One of the things that we learned very early on in this project is that people think about biodiversity in different ways and they value different aspects of biodiversity based on their research or based on the ways that they use or rely on marine resources. And so just to start, we’re wondering what you think about when you think about biodiversity.

**BD049:** Sure! Um, when I think about biodiversity, I think, you know, we want to have lots of different types of the same… well not necessarily. Like, we want lots of different things. Animals, plants, critters, etc. I think mostly my mind migrates towards marsh plants in particular, just because I’ve been working in marshes a lot lately. In that situation, when we’re thinking about biodiversity, we’re think about how many different species of plants are there. But you could out with somebody who looks at, like, the butterflies and the snails that are in the marsh. Like all the different biological organisms that the marsh hosts. And it’s going to be a lot for a marsh.

**Interviewer 1:** So I’m hearing - ok. So we have the species diversity of marsh plants is important, but then the diversity of all the other biological organisms in the marsh as well.

**BD049:** Yeah. Yeah, totally. And thinking about the marsh plants again, it’s probably true for all, diversity is generally a good thing. It makes an ecosystem more resilient if you have multiple different species. Some are going to be better than others at certain things, and so you get a storm, and you have sea level rise… the more diverse communities you have, the better. And there’s some work going on showing that there are some species that are facilitator species. Like when marsh is migrating due to sea level rise, there are some species that kind of help that transformation. So, where that came out on, is that where people do living shorelines for example - I’m just talking.

**Interviewer 1:** No, please.

**BD049:** They generally plant two different species, they do one in the high marsh and one in the low marsh, and over time I feel like some sites are able to naturally recruit other species, if that’s the right word. And some don’t. So the thought is that the more diverse plant species you have the more resilient you’re going to be over time.

**Interviewer 1:** Right, ok. Ok. So, I’m just going to start adding in concepts as you talk and start drawing relationships as you talk as well. But please, if a concept isn’t representing what you’re saying accurately we’ll adjust. We can remove, add, you know we really want the components that you see as most important. Because as you imagine, especially with scientists, these models get really complex really quickly. So - but you’re already like - sorry?

**BD049:** I don’t know too much about biodiversity, so…

**Interviewer 1:** No, no, everything - this is great already. And you know, we have a few other questions that we’ll ask to complete the model. And you were talking about sea level rise being an important component, and I was going to ask about stressors later, so I just went and added that for example. So I’ll do that as well as you’re talking.

**BD049:** Great!

**Interviewer 1:** Ok, great. So, we have diversity of biological organisms and diversity of marsh plants and you talked about those as important for system resilience. I wanted to add in another concept if you think it’s appropriate - what you were just thinking of, with what’s between the high marsh and low marsh, and the importance of certain species for mitigating its effects of sea level rise. Is there - do you think that’s encompassed already in the diversity of marsh species concept or is there another term that we could add in that’s important to capture?

**BD049:** Um, so, thinking about - well there are other stressors, but you said that’s going to come later, so.

**Interviewer 1:** We can add them now if - however you’re thinking about it.

**BD049:** Ok, so one thing that I think a lot about marshes in terms of stressors is sediment supply. So, really the two big stressors in my mind, there could be others, are sea level rise and sediment supply. So you have to have sort of a balance between those two things, or else your marsh is kind of going to drown.

**Interviewer 1:** Mhm.

**BD049:** Another thing that could become a thing, I don’t know if we’re really seeing it yet, but if there’s been changes in salinity, that might stress out certain organisms in the marsh. But in my mind, the two big ones are sea level rise and sediment supply.

**Interviewer 1:** Ok. Was there - was it marsh migration, that you said sea level rise… sorry, I know very little about marshes, personally. Is marsh migration, was that what you were saying? That the process of sea level rise impacts those dynamics with the high and low marshes?

**BD049:** Yeah, so sea level - if you don’t have enough sediment to keep up with sea level rise, then your marsh will either drown or it has to migrate land-ward, basically seeking high ground. It’s the same idea as people. If it’s too much, you have to go see higher ground. And so, there’s some barriers to that. The biggest one probably being people. You don’t really want that, right, we like our plant to stay where it is for the most part. Um, but you also need to have a slope that’s conducive to that as well. And so the idea of a more diverse thing is that there may be a species or two that can kind of help the marsh migrate so that they have a wider tolerance for flooding. And so, they can kind of maintain the marsh in a sense, while the other plants are resituating themselves along that elevation gradient. So you don’t lose your plants while you're migrating.

**Interviewer 1:** Got it. So the diversity of marsh plants is important for marsh migration. It’s a positive.

**BD049:** Yeah.

**Interviewer 1:** And sea level rise is what’s causing marsh migration.

**BD049:** Mhm.

**Interviewer 1:** Ok, cool. Ok. And then it sounds like with the slope as well, sediment supply is important for marsh migration as well, is that correct?

**BD049:** Yeah, because if you have sediment, then the marsh doesn’t need to go anywhere. It can just stay where it is.

**Interviewer 1:** Right. Ok, perfect. Um, and then, we’ve talked about biodiversity, we’ve talked about stressors. You mentioned coastal communities so I was going to ask you about what stakeholders are affected by these system dynamics, and related to that, what ecosystem services are important in these system dynamics related to marshes and biodiversity?

**BD049:** Uh, so stakeholders would be, I feel like, your usual folks. So managers, resource managers that are tasked with managing all the marshes of course, if you want to do anything to your marsh then you need a permit. So perimeters are important too. And then if you’re thinking about wildlife then the wildlife people get involved. I don’t deal too much with them, since most of my work now is in living shorelines and created things, I’m mostly dealing with resource managers, perimeters, and then property owners. And there’s also some non-profits. Like, folks that are trying to build living shorelines. Also the practitioners. So the companies that are actually building them. So my take on their perspective, which is super biased by my own biases, the landowners and individual property owners really just care that they’re not loosing land to erosion. I think some of them also want to do the right thing, and do the ecologically friendly thing and help out the bay and all that stuff, but when push comes to shove I think they’re mostly interested in mitigating that erosion and yeah. Some of them mow the living shoreline, so clearly they think that it’s affecting their view of the water, or else they wouldn’t mow it. I don’t - yeah, I don’t know exactly why they’re mowing. Well, one of them told me that’s why they’re mowing. The other one’s, I’m just kind of guessing that’s why they mowed.

**Interviewer 1:** Ok. Is it affecting their scenery and the aesthetics?

**BD049:** No, I think they have different values. Yeah, they just have different… I think their primary thing is that they want to stop their land from eroding, slash if you’re on the water and you want new construction, you probably have to do something as mitigation. And then secondarily, they want to do it in the correct way. So they’re ecologically friendly but they’re super concerned about cost. Mostly just cost.

**Interviewer 1:** Right.

**BD049:** What else… and the permitters, my sense of the permitters is that they want people to put stuff in that’s great ecologically without doing additional harm. So I think the permitters are the ones that have to balance the most trade offs because they have competing interests between the fish people, and the bird people, and the property owners, and the people that are funding things. And I feel like they just have the most competing interests to have to deal with.

**Interviewer 1:** Right. Right, that makes sense. Um -

**BD049:** And I don’t really know how they do that. We’re just trying to get them to tie in how these things do over time, so that it helps them at least know what to expect from a living shoreline project.

**Interviewer 1:** Right, ok. This is - just as an aside. Do you work with any permitters or waterfront homeowners who you think would be willing to speak with us about this stuff?

**BD049:** Um, so the permitters are at MDE, Maryland Department of the Environment. So the person there that we talk to is Tammy Roberson. I don’t know, but you can certainly ask her. I don’t know how she would feel about that. The practitioners… my sense is that they want a project that’s going to work, although how we define ‘work’ is super vague. I think work from the perspective of the people that hire them, being the property owners. So like, stopping erosion, not going away. So if I put in an elevation shoreline, I certainly don’t want it to go away the next year. Something like that. Yeah, I mean I think living shoreline is sort of a weird business. Because there’s obviously this very for-profit aspect of it, from the point of view of the practitioners, and so I don’t know.

**Interviewer 1:** Ok.

**BD049:** I think they’re definitely receptive to talking about, like, whether their designs are… basically what’s going to happen to a certain living shoreline over time, they’re certainly receptive to talking to me. They always talk to me. I don’t know that they would actually change anything based on any science that we do. I get a sense that they wouldn’t, but I don’t know if that’s totally fair to say.

**Interviewer 1:** Gotcha. Ok. That’s good to know. Alright, so I’m going to start to draw some lines here between these two components based on what you were saying. So practitioners want to increase erosion mitigation, as well as sea level rise.

**BD049:** Yeah.

**Interviewer 1:** And permitters - so we’re talking about the dynamics between permitters and living shorelines. So what effect do permitters have on living shorelines? Because it seems like it’s not always that they’re trying to increase living shorelines, it seems like they manage these trade offs like you were describing?

**BD049:** Yeah, so the permitters, like you can’t do a living shoreline unless you have a permit. And that’s issued from MED. So they have - there’s a law on the books for a while now that if you want to do something to your shoreline, you have to put a living shoreline. But there’s kind of loop holes around that. Like if you’re in a really high energy environment, or you have SAV in front of your site, those kinds of things. So the permitters are basically, like they get a design and the permitters have to say yes or no or do something different, but within the confines of the law. So they’re sort of - are you allowed to do that, is kind of their role, not necessarily if that’s the best thing to do, but is it legal.

**Interviewer 1:** Right, ok. Do you know what the name of that policy is? Or that act?

**BD049:** Um, I want to say it’s the living shoreline law, or something like that? Like the environmental law, they’ve been there since 2008? But I also have 2013 bugging around in my brain, so… no later than 2013 for sure. It may have been that the law went in earlier and it had to like wait to switch over. I don’t know.

**Interviewer 1:** Right. So, maybe - I’m going to stop there for a second. The last question I was going to ask you is what management approaches impact biodiversity in this system that we’ve drawn? So, you know, that’s why I was asking about living shoreline laws, and permitters, and living shoreline dynamics. Are there any other management approaches that we should add to this system before we start drawing more relationships?

**BD049:** Yeah, I mean, sediment layer replacement is a big thing. So adding sediment to the marsh. Taking sediment that gets dredged, and it has to get dredged, so the idea is that we have to dredge the channel because the channels that ships use we’re not really going to change those, unless we want to severely disrupt our economy. So we have to dredge, and then you need to do something with that sediment. It has to go somewhere. So the idea is if you can then put it on the marsh, you can help alleviate that stressor of sediment supply. And so, the idea is to do, you know, they call it a thin layer placement where they spray sediment on the marsh.They’ve done it at blackwater and they’re going to do it in a living shoreline maybe this year. I don’t know, but the idea is there.

**Interviewer 1:** Ok.

**BD049:** So the basic premise is to add sediment to the marsh to alleviate that sediment supply issue. And then - I don’t know if they then go back and plant… they must go back and plant the sediment that they put on top. But maybe in a natural marsh system they put just enough so you don’t bury the plants. I don’t know the ins and outs of that. But I know that that is one approach to manage marshes in general that are not doing so great with sea level rise.

**Interviewer 1:** Gotcha. So sediment placement mitigates sea level rise and sediment stressors.

**BD049:** Yeah.

**Interviewer 1:** Yeah, ok. So sediment supply is a stressor. We don’t want that in the system. Ok.

**BD049:** We want sediment, we don’t have enough.

**Interviewer 1:** Yeah, so that’s what I’m trying to - so sediment supply is… so we obviously want sediment. So sediment supply as a concept, our preferred state of that is actually positive, but you’re describing that as a negative because often times we don’t have enough supply. Is that correct?

**BD049:** Yes.

**Interviewer 1:** Ok, great. So then I’ll change that. Ok, great. Now what I want to do with these concepts is I’m just going to ask you to fill in the relationships between some of these system components. And I think we probably need to adjust some of the arrows that I probably have. So the way that we want to think about this is if a concept was to increase, would that cause an increase or decrease on the other system components? So, maybe we’ll start with the diversity of marsh plant species. I think that’s an easy one to start with. So, as we increase the diversity of marsh plants in the system, what would that impact with the other system components that we have?

**BD049:** Um, we have more diverse, we would be more resilient to lots of different things, it would be easier to migrate, it would host more other things - you can tell I’m not a biologist. Um, but the more different types of plants you have, the more associated things you can have. Because they’re all going to like something a little bit different. Yeah. It might be prettier. I don’t know, maybe that’s in the eye of the beholder, but I could imagine a beautiful wildflower. Which is not exactly the right analogy, but… I don’t know. Like I said, that’s in the eye of the beholder. Some people think it’s great, some think not. I don’t know.

**Interviewer 1:** Ok, that’s great. Sorry for the questions, because I know very little about marsh systems. I want to make sure I’m getting this right. So, I want to talk about the marsh migration concept really quick, because it sounds like, if I’m understanding correctly, if there weren’t any stressors in the system, the marsh wouldn’t need to migrate. We don’t want the marsh to migrate. Is that correct? Or is that a process that’s going to happen anyway?

**BD049:** Yeah. I mean, yes. So in general if we had sediment supply and sea level rise that would be able to keep the marsh elevation constant, with respect to sea level, then the marshes wouldn’t have to go anywhere. They could just stay where they are. We wouldn’t lose any, we wouldn’t migrate any, they would just be happy, stable places.

**Interviewer 1:** Ok. But in our current system, where we have sea level rise and sediment supply causing marsh migration, we need the diversity of plants to increase marsh migration because that essentially has to happen in light of the these stressors that are in their current state.

**BD049:** Yeah, yeah. So what we have now is we have fairly fast sea level rise, we’ve lost a lot of our sediment supply, and so there’s not enough. That balance is off kilter. And so the sea level is rising faster than our marsh is building up. And so they can only either drown or migrate.

**Interviewer 1:** Right.

**BD049:** So I feel like, if you were more diverse, I feel like you would also be more resilient to drowning. In the sense that each plant has a different tolerance to how much - how often it can be flooded. So if you have more types of plants, then you would have more built in ways to deal with the flooding.

**Interviewer 1:** Ok, so maybe marsh drowning - resilience to marsh drowning is how you would describe that, right? Or marsh…

**BD049:** Yeah. More diverse would make you more resilient to drowning.

**Interviewer 1:** Ok. Would it decrease drowning? Or is that non the right way to think about it?

**BD049:** Uh, I think that’s fine.

**Interviewer 1:** Ok, because then we’re saying that sea level rise would increase marsh drowning, is what you’re saying.

**BD049:** That’s for sure.

**Interviewer 1:** And increasing sediment supply would also decrease drowning. That would be negative.

**BD049:** Yeah, yeah.

**Interviewer 1:** Ok. I just want - I was getting a little tripped up because we have positive arrows coming of sea level rise and diversity of plant species, so is that all to marsh migration if that makes sense? So I was trying to think - marsh migration, with the preferred state. Is that… do we want that? Do we not? But I think it’s accurate how we have it now. Because sea level rise is causing marsh migration in our current state. That’s just the reality. And so we need diversity of plants and we need more sediment supply to facilitate that migration that’s going to be inevitable once we have more sea level rise. Right?

**BD049:** Yeah. I mean, if possible. I don’t know that lots of people want marsh migration. But we’re definitely not Louisiana marshes, so…

**Interviewer 1:** Right, ok.

**BD049:** That’s the other option.

**Interviewer 1:** Right, ok. I think I’m going to leave that. I think that that makes sense. So, before we go on, the only other thing that I was going to ask - and I know that this is already complex. So it’s totally fine if we can’t do this. But the other thing that we can do with the models is we can categorize our relationships based on their relative importance in the system, the relative impacts. So we can say does this relationship have a low, medium, or high impact to the other system components? To kind of categorize which relationships are driving the system dynamics. If that makes sense.

**BD049:** Mhm.

**Interviewer 1:** So as we go, if there are certain relationships, like with the ones we’ve already drawn, for example, coming out of diversity of marsh plant species, if there are specific relationships that you think have a higher impact, then we can categorize those as well as we go.

**BD049:** Ok.

**Interviewer 1:** So for these concepts here, are there any relationships that you think would have a lower impact than the others? I automatically set them all to one, which is the highest, but we can lower them if there are ones that you think are maybe less important to driving system dynamics.

**BD049:** Um, I would say that scenery is pretty low importance. I don’t think that people actually care too much about that.

**Interviewer 1:** Ok. Sounds good. And then, so maybe let’s go to diversity of biological organisms in marshes. So how would increasing that impact the rest of the system?

**BD049:** Um… it impacts - so if you have more diverse other things, then you’ll have a fuller food web situation. So, like, lots of things use marshes. So they’re really important for migratory water fowl, which is top of my mind because there’s like a million geese around Cambridge right now. Um, so then they need food, they need places to hang out. There’s like… fish use them sometimes, some of the birds can eat the fish, there’s snails in there that are using the plants as kind of a refuge, um… there’s all kinds of microbial stuff that’s dealing with nutrients. I think you probably would be able to maximize your nutrient storage with the - if you had more diversity. Which is another important ecosystem thing for marshes.

**Interviewer 1:** So, one of the things - I meant to mention this earlier. One of the things that we’ve been doing as a team is trying to come up with a framework for how to conceptualize biodiversity when we’re kind of coming up with these definitions through these interviews. And so one framework especially in particular that we’ve been outlining has four key components. And I wanted to ask what your thoughts were on that and if you’ll see if we wanted to add those components. And we already have a lot of components, and I think we’ve already touched on a few of them, but I’m just going to add them in for now and then we can take them out and see if they fit into the system that you have. But one of them is key food web supporting species, which you were just talking about. So I wanted to go ahead and add that. One is habitat forming species, which we’ve already talked about with marshes so that might be redundant, but I’ll add it in. And one is species of conservation concern.

**BD049:** Oh, the salt marsh sparrow! People keep going on and on about that salt marsh sparrow. That’s the extent of my knowledge, pretty much.

**Interviewer 1:** No, ok.

**BD049:** But I do know that there’s a lot of threats to the salt marsh sparrow, and whether it’ll get listed, and there’s a lot if land that’s been restored so that there’s more habitat for that sparrow. I’m sure there are others, but that’s - like last weekend, everybody was super worried about that.

**Interviewer 1:** A sparrow, ok. So this is great. What else - I was thinking because, so we have these four bins, and maybe I’ll leave them there to the side, but I think it would be really helpful to us as we’re thinking about specific local themes in the Chesapeake Bay. You know, you just talked about the salt marsh sparrow as a species of conservation concern. Adding in that specific species maybe, since that’s how you’re thinking about the system. So I’ll leave these. And then, were there specific key food web species that you wanted to add? Or we can just leave this as an overarching bin here.

**BD049:** Yeah, I think it’s overarching. In my mind it’s the connection - marshes are the connection between the land and the water. And so there’s lots of organisms that need to find shallow water, so if they’re not in the marsh they could just be right adjacent to the marsh perhaps? And maybe they just come in in high tide. I don’t know if that’s actually true, but that’s my idea at least. So, there’s often - there could be SAV beds next to the marsh, and those could be really good habitats for fishing crabs and all of that fun stuff. So, I think it’s just a really good environment to have that transition space between land and water, that a lot of organisms kind of need. Like sometimes they’ll be crabs. And I don’t love it but they’ll be snakes every once in a while. And turtles. Like there’s lots of… I feel like there’s just - that connection is really important. And where we don’t have that marsh, like out here it’s really hard to harden the shorelines in places.

**Interviewer 1:** Yeah, ok. So, I went ahead and added SAV beds. I think for habitat forming species it seems like marshes and SAVs are kind of the core ones. Um, were there any - does harmful organisms, does that resonate with you? Are there any specific ones that are kind of important to ecosystem dynamics that we should think about?

**BD049:** Um, I’m sure there are but I don’t really know any.

**Interviewer 1:** Ok. I’ll just put that. So, maybe for the sake of time, I’ll go ahead and move this over here. Um, and I’m just wondering when thinking about this core group of biodiversity components over here, if there are any key relationships that we want to emphasize between the biodiversity components and system dynamics?

**BD049:** Um, we definitely emphasize the resilience piece. Not just to sea level rise, but also storms, shifting climates - like if we start getting warmer, if we start getting more rain, if our winters don’t freeze. Like there’s - I feel like the more diverse populations you have, the more resilient you’ll be to changes like that. Our marshes don’t really care too much about freezing, but up in New England they think about that a lot. I don’t know that - I don’t really think about temperature so much for the plants, but I could see temperature and like the securiticity of the growing season impacting something. Not that I know that at all, but that is… I feel like it only could be, I don’t know. I probably shouldn’t say, I’m just thinking.

**Interviewer 1:** Ok, great. Are there any other relationships that we want to add from these biodiversity components?

**BD049:** Um… I mean the food web is important. I feel like I tend to lump all of that under resilience. So, yes it’s important. And to me it’s part of that whole thing.

**Interviewer 1:** Ok. So all of these biodiversity components are important for ecosystem resilience is what you’re saying?

**BD049:** Yeah.

**Interviewer 1:** Ok. And are these, when thinking about those weights again, do all these biodiversity components all have relatively equal importance for ecosystem resilience, or are there ones that you think are more important than others in driving system dynamics with regards to resilience.

**BD049:** Um, so for resilience I feel like the most important things are having diversity, and that - really the main drivers are sea level rise and sediment. And I think that that is what drives the whole kit and kaboodle, and can then affect the other things.

**Interviewer 1:** Ok, so maybe our diversity components, our sediment supply, and sea level rise, are high, but then nutrient storage, food web, SAV, are little lower in their weights?

**BD049:** I mean I guess it depends on your - like to me nutrient storage, key food webs, all of that, they come out of having a diverse marsh which is set by the environmental conditions. So they’re sort of the outcomes of having a diverse assembly. You get all of that great stuff and that great stuff is then more resilient to change. So I guess it’s a two way arrow maybe?

**Interviewer 1:** Yeah, ok so these guys are import for diversity, is what you’re saying as well. Ok.

**BD049:** Yeah. And I think they’re all feedbacks.

**Interviewer 1:** Right.

**BD049:** Yeah. I mean, diversity can’t affect sea level rise. But more diversity may help with capturing more sediments, maybe. If you have enough in the system. So the main driver would be like do you have enough, and then the second thing is, like, can you get it to stay on the marsh platform. And I feel like you would want to have a pretty diverse community if you could. Kind of like an all hands idea. But you first have to have enough. If you don’t have enough, then it doesn’t matter.

**Interviewer 1:** Ok. Is that diversity of marsh plants and diversity of all other organisms increase sediment supply?

**BD049:** Um, so it wouldn’t increase sediment supply. It would increase how much sediment stays.

**Interviewer 1:** Ok.

**BD049:** Which is also sediment supply. I think it’s mostly just the plants, although you know that there’s biology that can make things sticky? Like, bacteria and mucus in algovats. So there are some things that help retain the sediment in the marsh and allow it to stick to the plants. So, I think that you would want - as long as you don’t have too many things that are going to eat the plants. But diverse communities that are not plants can also help build resilience of the whole situation.

**Interviewer 1:** Ok so the linkages are more important to resilience from this diversity of all organisms than to sediment, it sounds like.

**BD049:** Yeah. I think so, yeah.

**Interviewer 1:** Ok. And then - so I added feedback loops between diversity of biological organisms with our other biodiversity components. Do those feedback loops also apply with the diversity of marsh plants?

**BD049:** I would say yeah.

**Interviewer 1:** Ok, so we’ll do this… you can see how things get crazy quickly.

**BD049:** Especially because all of the things feedback on all of the other things.

**Interviewer 1:** Yep, yep. We hear that a lot. Is there anything we want to add connected to the salt marsh sparrow? As a species of conservation concern.

**BD049:** I don’t know. I mean, they definitely use marshes. I don’t know if they care what the plants are? I don’t know. I would imagine that you probably - I think they’re using it for nesting and stuff like that, so I think that you would just want a really resilient marsh. Like one that’s going to stay there year after year. So the way to do that is to build system resilience and have more diverse species, and that sort of thing. But I really don’t know what they’re exactly…

**Interviewer 1:** Ok, so resource managers care about salt marsh sparrows. It sounds like.

**BD049:** They do, yeah.

**Interviewer 1:** Ok. With our remaining ten minutes, I would love to add in some relationships between our components of management, services, stakeholders, that kind of stuff. So, maybe let’s start with our management. So like, living shoreline law, living shorelines themselves, permitters, resource managers… what do those impact in the system?

**BD049:** Um, so, resource managers that we work with at DNR, they advise property owners on what to do with their shoreline. They of course want to mitigate erosion, and they want to do it in an ecologically friendly manner. And they’re putting in living shorelines themselves, and they’re super interested in the performance of that living shoreline over time, and how do you define successful living shorelines.

**Interviewer 1:** So, I have them to living shorelines, erosion mitigation, was there anything else I missed there?

**BD049:** Uh… no I think that’s good. I think that the resource managers also probably care the most about getting that ecological benefit as well. So, like, all the things that marshes do for us, storing nutrients, food webs, etc, because they want to restore the whole system.

**Interviewer 1:** Right.

**BD049:** To be… like the idea is that we’ve lost a lot of our marshes so we should put something back and also help with erosion mitigation. So they’re balancing the fact that, like, with sea level rise we’re getting a lot more erosion. So I guess erosion is still a thing, but it’s being driven by sea level rise and storms.

**Interviewer 1:** Ok. So…

**BD049:** Yeah, I think they’re more of a holistic approach.

**Interviewer 1:** Ok. And so, would you say those arrows are relatively equal in their weight, between erosion and those biodiversity components for managers?

**BD049:** Um, that’s probably true, yeah. You might want to talk to some folks that can actually tell you whether that’s actually true.

**Interviewer 1:** Yeah, ok. And then… what about our other stakeholders? Permitters, yeah, like the relationship between permitters and living shoreline law and living shorelines themselves.

**BD049:** Yeah, so the permitters are basically responsible for making sure that whatever happens on the shoreline is legal with that law. So, I don’t know the history of the law and how it came to be, like who… the driving force behind that law. But they’re the ones that are responsible for making sure that basically it’s followed. That it’s legal. I think they also want to make sure that, I don’t know how to say it… permitters worry a lot about the impacts of putting in a living shoreline, or doing anything with shorelines. Or any sort of marsh creation, restoration, situation. Because they want the benefits the be better than the risks or the negative stuff. But negative defined by whom? So I think that they’re in the sort of ‘do no harm’ kind of situation? I feel like a lot of times with living shorelines they’re concerned about SAV beds and the impact that things that you do on a shoreline, whether it does or does not impact adjacent habitat. I mean, SAV is this species of concern. I guess you could list that as a species of concern. I mean, it’s not in the language of endangered species, but in the Chesapeake SAV is used as like, a keystone species by which water quality stuff is set and all that stuff. So in a lot of ways it is a species - and it’s not just one species. It’s the thing that is most used. So yes, so they worry a lot about impacts to adjacent habitats. And my impression is that they’re sort of the doctor ‘do no harm’ kind of thing, so they only want to help.

**Interviewer 1:** Right, ok. Cool. What about property - oh sorry. I’m going to go to practitioners really quick, because I feel like that fits in a similar bin. Are there any other - we just have practitioners to erosion mitigation. Is there anything else in terms of how practitioners fit into the management dynamics?

**BD049:** Um, they would like to do what they would like to do. So - which is perhaps a little bit cynical. There’s some that are interested in innovative approaches. But basically, they want to get a permit so they can do their thing.

**Interviewer 1:** Gotcha. Gotcha, ok.

**BD049:** And they’re I think driven mostly by the property owners. So they want to be able to do whatever the property owner… because the property owner is the one that’s paying them. So they’re the customer that needs to be kept happy, not necessarily these other folks.

**Interviewer 1:** Right, ok.

**BD049:** I do think that some of them genuinely also want to do the ecologically correct thing, but I do feel like if they were forced to choose, they would choose the erosion side, because that’s what the property owners are most interested in.

**Interviewer 1:** Right, ok. So I have those connected to erosion. So how does cost fit in? Because you mentioned that trying to be mindful of cost is important to property owners, obviously.

**BD049:** Yeah. It is. It is, and I think that that’s an area that we still need to work on. And property owners see the dollar signs of what it costs to install it, but we don’t talk too much about what the cost is to maintain it. It’s going to be a lot lower for something that can kind of move along at its own pace. It’s probably going to grow, but it’s probably not super big either. And then we also don’t talk about the ecosystem benefits. So if you want to be able to go swimming, or crabbing, or whatever and you’re adjacent water, it’s probably going to be better if you have a living shoreline to trap your sediment.

**Interviewer 1:** Right, right. Ok. Living shoreline… so then how do they relate to sediment supply and erosion mitigation. It seems like there is an important connection there.

**BD049:** Yeah, so it’s a way to mitigate erosion. And because you’re creating a marsh, so you’re dumping in sediment and then you’re planting it and you’re hoping that the marsh can then sustain itself. So at that point, the living shoreline is subject to the same stressors that a natural marsh is. And so, what you would want over time is for that living shoreline to become more diverse.

**Interviewer 1:** Right, ok. Just the last thing, because I know we’re just about out of time. We have changes in salinity as an important stressor, but we don’t have it connected to anything. How does that impact the system?

**BD049:** I don’t know. Yeah, I mean, I don’t totally know. All I really know is that some plant species are more tolerant to salt than others, and there’s different bio-geo-chemical processes when you have salt water vs freshwater. I don’t know if that’s really… I don’t know the pace at which changes in salinity are occurring. So it’s definitely not a right now situation, right now we’re just concerned about sea level rise and sediment supply, but I can imagine that there could come a time where changes in salinity may become important.

**Interviewer 1:** Right. Ok, great. So I’ll leave that to the side so we know that, but it seems like maybe it’s not important to connect in now.

**BD049:** Yeah.

**Interviewer 1:** Ok great! Well I know that we are out of time, so I’ll stop there, but thank you so much for taking the time to meet with us today, we really appreciate it. And it really was helpful. Your model is really cool, so it’s really informative in a new perspective that we haven’t heard yet in terms of sediment supply dynamics and some of the erosion mitigation stuff so, very helpful.

**BD049:** The perspective of a non-biologist. I’m like, I don’t know, I’m sure biodiversity’s important.

**Interviewer 1:** Yeah! And if you can think of anyone else that may be willing to talk to us on the side of permitters, practitioners, property owners, that would be great. But no worries if not.

**BD049:** Ok! I will let you know.