5/31/2024 - BD057

**Interviewer**: So, Mental Modeler–can you see my screen, does that look okay to you?

**BD057**: Yes I can.

**Interviewer**: Perfect. So, Mental Modeler is a tool that we use to… we call them mental models because it’s to capture how an individual thinks about their system or thinks about a certain research topic and so my plan is to go through a couple questions and while we talk, we’ll build out a concept list, and then what we use this tool for is to understand how those concepts are connected to one another, so to see if one system component was to hypothetically increase, how would that impact the other system components in the map that we’ve drawn. So, just to get started–and you already answered this question a bit in our precursor conversation but I’m first curious to hear when you think about biodiversity, what do you think about. So of course we talked about habitat a little bit but if we could structure that as some system components to get started… so I know like habitat diversity I’ll just add in from the conversation we had before but what would be some other key components when you think of biodiversity, how do you think about it?

**BD057**: I think of the beauty of nature.

**Interviewer**: Okay. And then I want…so you were talking about habitat diversity and then talking about like creatures and habitat as well, like I’m trying to think about how to phrase that, I think those are kinda like the two core components you were talking about right?

**BD057**: Yeah, I guess, you know, in my non-EPA world, I really think of it as the beauty of nature. In my EPA world where we’re trying to figure out ways to set targets, yeah I mean I do think of it as habitat driven, but I’m doing a lot of work with invertebrates and fishes and things like that and so I do have a decent understanding of why a mix of creatures and diversity is important to the ecosystem. So, you might put like healthy ecosystem.

**Interviewer**: Okay. Great. So, one thing that we’ve done as a team is come up with a framework of how to think about biodiversity, specifically species diversity, and so I’m gonna populate those concepts in–there’s four of them–and then I’m wondering if you agree that these are kinda the key components of marine biodiversity and if they’re things that you think about in your work and I already know one of them is yes, habitat forming species.

**BD057**: Yes, that’s a yes.

**Interviewer**: And then key food web supporting species, species of conservation concern, and harmful organisms.

**BD057**: Yeah, those are all…there all in there, by all means.

**Interviewer**: Okay, great. What’d you say?

**BD057**: You’ll forgive my poor eyesight.

**Interviewer**: And then, okay so next so I know another thing that you were talking about that you do in your line of work is think about ecosystem services and so I’m wondering what ecosystem services do you see as important in receiving from biodiversity?

**BD057**: Enjoyment of nature, that’s one, and fishing, healthy ecosystems… I guess those are the ones that I would think of. I know my ecosystem services friends would have a large list but those are the ones that would come to me.

**Interviewer**: Okay, perfect. And then, we’re wondering–like I said at the start–so one of our goals is to understand how we’re managing for biodiversity, so I’m wondering what management approaches you think are currently managing for biodiversity either directly or indirectly. And when I say management, like I know you work for EPA so we could also add in some components–like I want this to represent your line of work and area of expertise, so if we add components about the bio\_\_?\_\_ assessment program too, like, I’m trying to represent kind of your knowledge in the space.

**BD057**: Yeah, okay. My management is all non-regulatory, right, so it’s all about, as you say, decision making tools to help communities make, you know, the wise decisions that benefit nature I hope and themselves, right, so nature and society, so you know, in my case, we manage for diversity indirectly, right. I don't know…well, untrue. Susan Jackson manages for biodiversity directly with her IBIs and let’s see…and there is an IBI function in estuaries too and that’s also…well it is based on diversity but it’s translated as species tolerance, so you look at a list of…yeah, yup, and I mean, that’s also true of the IBI, right, where you look at the tolerant species versus the sensitive ones and so, and I guess that’s sort of indirect biodiversity too though right because you’re not managing biodiversity, you’re managing for a set of creatures.

**Interviewer**: Right, okay. Sorry, will you remind me what IBI stands for? I’m sure you already said it but.

**BD057**: Sure, yeah sorry, Index of Biotic Integrity.

**Interviewer**: Index of Biotic–okay, so should we add that as a concept do you think or…I’m sorry I already forgot–Index of what?

**BD057**: Biotic Integrity.

**Interviewer**: Yes, I talked about this for a while with Susan, yes. It’s all coming back. I have so many of these meetings and I talked to Susan like three weeks from now and it’s like…

**BD057**: Yup, yup, yup.

**Interviewer**: Okay, great. And there was something else you said around the Index of…it’s like tolerance of species, does that go hand in hand with this, like that’s what that is right?

**BD057**: Yeah, that’s pretty much what they usually are. I mean there’s a bunch of them but usually it has something to do with species tolerances. And to do that in the marine setting, or in freshwater, you have to collect all the creatures that are there and identify them all and usually sometimes count them all, right, so that actually, you have right there the data for a straight biodiversity, and I think people have tried to do that but mostly it’s for regulatory purposes, not research purposes, and so they tend to stop at the IBI and often this is done by contractors, contract staff, because it’s so time consuming to extract these creatures and species and whatnot and so with that focus, often the sciencey parts are deprioritized over the regulatory parts. Yeah, so…is my video clicking on and off?

**Interviewer**: Yeah, it is but I mean it’s fine. It doesn't bother me. Whatever works.

**BD057**: Okay, there we go. Yes, yes, yes. Okay so, we got the IBI, now another I was testing out to look specifically at biodiversity and compare it to other measures, and what I did is in one of my camera systems–I use cameras that look straight down at the seafloor and one that like plunges into the seafloor and you look at the seafloor from a profile, from the side so you can see the surface and then layers of mud underneath, and so actually in both of those, I’ve tried…and they’re analyzed using CMECS, the Coastal Marine Ecological Classification Standard which is the federal standard for classifying all things marine and coastal, and it has great value just as a dictionary, but also in hierarchically organizing all these creatures–I worked on that quite a bit actually…it’s NOAA but I work with NOAA. And so basically it bins creatures and basically assigns their taxonomy, so it’s really just a dictionary, it’s non judgemental, it doesn't like exclude anything but it relies on things that you can see looking down at the seafloor, and so it’s a visual thing and we wrote a section of it that applies to looking at the sediment from the side too and so with CEMACS, you group things into categories because you can’t speciate with an image at that small \_\_?\_\_ level, so CEMACS gives you things like small surface burrowing fauna, small tube building fauna, large deep-burrowing fauna, categories like that, again because you don't know what the species are and so I tried to look at diversity by the number of categories that were there and it did actually work fairly well in terms of predicting condition. I didn't really take it much further than that, I have to admit, because it…I don't really know why I didn't. Because I had all these other things that worked and were proven and the whole thing for me was about again non-regulatory decision making so…and I wish actually that…I mean we do have a good research focus where I am at the Office of Research and Development at EPA but it is all pretty tied to things that people would use to make decisions and I guess I saw it more as a fun side project and that’s how I did it as, you know, I counted all these things up and I compared them and it looked pretty good, it did, but it’s competing with all these other tools that people use that are pretty well established, so that was my little foray into biodiversity, again by proxy of groups, right, so the proxy is if you have small burrowing and small tube building and deep burrowing and you know, epifauna, then you have great biodiversity even if you haven't speciated them, you’ve looked at the…so it’s like biodiversity of different functional groups. That’s what it is…functional group biodiversity.

**Interviewer**: Okay, okay, so it sounds like we should add that in…functional group…okay, I’ll put that over here. Okay, great. Is there anything else that…now I want to call it an index but that’s not true, but the data set that you’re talking about that you were collecting with your camera data…I’m wondering if we should add something about having data sets of biodiversity that then help inform management decisions, right, like that’s how…we need that data to then hand off to the decision makers to inform their decision making.

**BD057**: Yeah and the way that works is you go with an established method bioassessment because to manage, you need something established and that people trust, right, on the other side, on the research side and development, you come up with it yourself and test it and that is something actually I’m doing with the CMEAS(?) surface cam(?) and so basically they all kind of work the same way which is you figure out what’s there, species, biodiversity, functional groups, and then you apply that to a framework that scores them and gives you a number and that’s the quantitative number that reflects condition, ecological condition.

**Interviewer**: Right, so it’s like biodiversity data for bioassessments is like what you’re describing right?

**BD057**: Um, yeah I mean you could say that but it’s not based on biodiversity. It’s based on essentially like some species are you know, present in really high conditions like digging things, right, and some other groups are associated with very poor condition like small worms at the surface who can live in anything, so you basically like one point for the small worms and three points for the big burrowing things and then it all adds up and you know, you take that score, in the case of the index I’m talking about it’s from zero to 15, and you use that to assess condition and typically you divide that number into like something like good, fair, poor, with three or four or five divisions, good, fair, poor, awful. Excellent, good, fair, poor, terrible, that’s the five, yup.

**Interviewer**: Okay, and that’s the bioassessment that the EPA does, what you’re talking about?

**BD057**: Yeah, yeah. I mean the EPA uses a lot of ways of bioassessment, right, and so I’m not familiar with all of them but the benthic bioassessment is a big piece of it because creatures of the seafloor don't go anywhere and they change on a slower time scale than like fishes or birds or you know, yeah, whales, dolphins, so a lot of EPA bioassessment on the benthos.

**Interviewer**: Gotcha, okay that makes a lot of sense. Okay, great. And then, the last thing I was gonna ask you and then we could start connecting some of these things are are there any stressors that are impacting biodiversity or these management decisions that you’ve been talking about in your line of work?

**BD057**: Yes indeed. The work I do with the camera is all estuarine and so it’s nutrient and dissolved oxygen driven, that’s the biggie in estuarine benthic ecology because if you get too many nutrients, then the plankton go nuts and then they die, they sink, they rot, and then they use up all the oxygen and everything on the bottom dies, so there’s a gradient of, you know, how much nutrient is being put in there and how it affects the oxygen at the bottom and there’s a lot of variability there because it also depends on stratification and wind energy, things like that, enclosure of the area that you’re looking at, and so that’s kind of the challenge of it, but basically if you see a seafloor that is really healthy with a lot of big, large burrowing things and stuff on the surface, then that is an indication that it’s not seeing a lot of DO problems, whereas if you see something again and it’s just a lot of little tiny worms, that is more indicative of dissolved oxygen problems and the extreme is anoxia or severe hypoxia when there’s actually very little air, so in some ways that is actually, although I didn't really think of it that way, it is a biodiversity scale, you know, you start with very very few creatures and it goes up to more and more creatures as oxygen increases and that is usually…well the way we do it in imaging is you develop like certain quantitative ways of assessing, like you count things per square meter or whatever it may be and then you again you put them into an assessment framework or one of the already developed tools.

**Interviewer**: Right. Okay. Okay, great. Okay, that is really interesting and great to know. I just added in basically what you just talked about as like a little model which I think is a great segway to what I wanted to do next of starting to connect some of these components so if I heard you correctly and I understand correctly, so nutrient runoff is a big stressor and the more nutrient runoff you have, you–oops this is gonna actually be positive–so you increase nutrient runoff, then you will increase hypoxic conditions, right? And then if you have more hypoxia…

**BD057**: Plankton should go in the middle there. So it would go nutrient runoff, right, and then that fuels plankton growth. Then the plankton would rot and use up all the oxygen. It’s plankton and macroalgae.

**Interviewer**: Nutrient runoff increases plankton and then plankton will increase–or wait, sorry will you say that again?

**BD057**: No you’re right, that’s it basically but it would be better to put plankton like slash macroalgae because they are an equal contributor to this. This is the basic paradigm right so nutrients lead to all this plant growth and that sinks and decays and uses up all the oxygen.

**Interviewer**: Okay, so the more plankton macroalgae then we have more hypoxic conditions, and then more hypoxic… hypoxic conditions are bad for benthic diversity that decreases.

**BD057**: Uh, right. That’s it.

**Interviewer**: Alright, perfect, great.

**BD057**: And actually it’s not nutrient runoff that one specific way of getting nutrients in, like that’s when it runs in from the land but there’s also like sewage stream so it should say like nutrient input, that would be a better way to put it, or nutrients that’s good, or nutrient levels, something like that, yeah, yup. Input’s totally cool.

**Interviewer**: I’ll add more detail. Okay, great. So, I know we’ve already been talking for a bit but just the last thing–and we could do this for hours as you can imagine is like go through and talk about every possible connection–but maybe I’ll just start with some of the biodiversity components cause that’s what we’re most interested in. So, like habitat diversity, for example, cause I know you said that’s important, so if we were to increase habitat diversity, what would that impact in this system positively or negatively?

**BD057**: Everything on the upper half there, right, fishing, enjoyment of nature, beauty of nature, healthy ecosystems, habitat forming species, I would say…well again, I take habitat as a proxy for biodiversity, right, so that would also be key food web supporting species absolutely because they are associated with habitats. \_\_?\_\_ with species of conservation concern alone but…oh yeah, yeah, yeah they would be in there too. And yup, harmful organisms, yes, cause they tend to be focused on a habitat and yeah, functional group diversity, and nutrient input…yeah cause that’s the benthic habitat, so I’m giving everything.

**Interviewer**: And…you said and what was the last one you said?

**BD057**: The nutrient input leading to benthic–cause that also like just kills seagrass, right, so that’s another indicator of nutrient input is seagrass loss, which is a huge one for biodiversity.

**Interviewer**: Okay, so the arrow goes this way your saying is nutrient input impacts habitat diversity?

**BD057**: It does, yes cause basically it’s bad for the creatures who live on the bottom and the creatures that need clear water, so seagrass and benthos.

**Interviewer**: Seagrass and benthos, okay, perfect. Okay. Did you say habitat diversity was connected to benthos diversity or are you saying through the nutrient input chain?

**BD057**: I see habitat diversity as like deepwater, shallow water, beaches, marshes, seagrass, so I see it as like all the major habitats that are there and you know, there’s actually a lot of habitats if you go and look at them but in our work we can’t quantify all of them. What we do actually is we have sourced these–in the Northeast–these incredible maps from the Revolutionary War so like 1775 because both sides, the British and the Americans, did some just amazing mapping for that war and the way they did it seems really primitive but the maps are like incredible, like the cartography and the way they absolutely capture the exact outline of what we know to be and they include a lot of habitat, like there’s always salt marsh that they identify specifically. One of them, my very favorite, also identifies seagrass and they also identify like the creeks and the, you know, so they’re just spectacular so that’s how we get the ‘what did we have’.

**Interviewer**: Yup, okay gotcha. Okay, good. That’s very cool. Okay, so then maybe let’s go to healthy ecosystems. So what does increasing the health of the ecosystem impact?

**BD057**: I’m giving it everything too.

**Interviewer**: Okay. Okay, this… actually, I’ll add these in after cause, as you can imagine, the arrows get crazy.

**BD057**: Yes, yes I can see that.

**Interviewer**: Yep, so same arrows that we just had from habitat diversity I’ll apply to healthy ecosystems, is that right?

**BD057**: Yes, yep.

**Interviewer**: Okay. What about these four bins for species diversity? What do they impact?

**BD057**: Okay, I think that habitat forming species and key food web supporting species do lead to changes in biodiversity when you change those. Species of conservation concern and harmful organisms I see as like very few species and so unless they are replacing natural species, they seem to be less so to me if you're just adding a species, or you know. But if they’re in there like clobbering all the other species, then that’s another thing.

**Interviewer**: Right, okay. So when you say…are you just talking about the habitat diversity bin or when you say impacting biodiversity, we could just add like a biodiversity concept or is there something in here specifically that you’re thinking of?

**BD057**: Yeah, yeah, yeah, biodiversity would be its own box.

**Interviewer**: Okay, great, let’s see. Okay, so you said that species of conservation concern and harmful organisms are less so, so one thing I didn't mention is we can with this tool we can add a weight to the relationships so we can say that one concept has a low impact on another versus another concept may have a medium or high impact, so we could add in arrows from species of conservation concern and harmful organisms to biodiversity and make it a low weight if that represents what you said accurately?

**BD057**: Yep, yeah, I wanna make another comment here. To me, biodiversity and habitat diversity are kind of one in the same. So in that middle one you could say habitat diversity slash biodiversity.

**Interviewer**: Okay, yeah I can do that. So then maybe what I’ll do is I’ll take…I’ll do this after we get off the phone just cause it’ll take a bit but I’ll just change those concepts that we just added to habitat diversity is what you’re saying?

**BD057**: Mhm, yeah, I think you can get rid of mosaics too cause that’s just a way of measuring habitat diversity.

**Interviewer**: Okay, perfect, we’ll do that. Okay, and then I’ll just stick this here so that I know that I’m gonna change those after. Okay, great. And then what about our services, so like the beauty and enjoyment of nature, and are those the same or are those different? The beauty and enjoyment of nature?

**BD057**: I think they are different but I think it’s cool to combine them. I think you can combine them. But like you see what I’m saying, there’s like a subtle difference. Is it beautiful? Yes.

**Interviewer**: Okay. Okay, so then and then we had, do we have anything else? I think those are our core ecosystem services so what do they impact in the system?

**BD057**: They impact people’s willingness to make decisions, right. Yeah, I see those as…

**Interviewer**: Okay, so maybe I’ll add another concept…willingness to…how would we describe that? Willingness to…

**BD057**: Um, support? Support environmental improvement? I don't know.

**Interviewer**: I like that, okay. Support environment improvement. Okay, and so increasing this and this has a positive impact on this is what you’re saying?

**BD057**: Right, as would so many other of these benefits that people derive from nature.

**Interviewer**: Right, right, okay. Okay, great. What would then increasing that willingness to support environmental improvement, what does that impact in this system?

**BD057**: Decision making. Yeah, so that’s decision making so I think that that can have a positive influence on all these things, right, so for instance, if we decide to reduce nutrient input, then that affects that whole line down below but it also affects seagrass and therefore habitat diversity and so it kinda resonates through the system.

**Interviewer**: Okay, so this would increase habitat biodiversity and then this impacts all these other things basically that we talked about. Is that right?

**BD057**: Yeah, yeah, I mean, I think that’s it. Yeah.

**Interviewer**: Okay, awesome. And then, so we have these guys over here, so these are–well actually sorry, I missed this guy over here–so we have the functional group biodiversity…should that stay as a separate category based on what we talked about?

**BD057**: No that can go with the biodiversity block there, you know, it’s just a different way to look at biodiversity, you know what I’m saying, I don't think it’s any…I guess, you know, sort of like three biodiversities, not just, what is it, the \_\_?\_\_Weezer(?) of species, that kind of thing, to me it can be measured in many different ways like habitats or functional diversity, right, and those are all important ways to categorize it. In fact, in some cases like functional, they may be more important than just, you know, how many species you have. You see there’s all these different components of biodiversity. In fact, you could say that functional biodiversity is a result of biodiversity of creatures that do specific things in the environment.

**Interviewer**: Right, okay. Okay, should we draw that out as a separate thing, do you thing that’s important to separate out?

**BD057**: No I see it as all part of the same bin, you know, like diversity of all kinds, right. It doesn't really matter how you measure it, it’s all diversity, it’s all biodiversity.

**Interviewer**: Yup, okay, great. Okay and then what about these…so we have the species tolerance indices and then we have the benthic bioassessment, so are those…do those impact anything in the system or are they impacted by anything in the system?

**BD057**: I would say they are indirect measure of biodiversity, they just are, but it’s indirect, and they affect the willingness to support environmental improvement cause it’s basically, you know, a ‘how are you doing’, if you’re doing really badly then you may want to support environmental improvement.

**Interviewer**: Right, okay, great, awesome. And then this little guy down here, so I kinda made this as like an example based on what you were talking to show you how we’ll do this but we can…do you want to keep that in and then we should add the components like, talk about how they impact the system?

**BD057**: Actually nutrient input level is a human thing, not a nature thing, so you can actually put that on willingness to support environmental improvement by way of decreasing nutrient input would result from a willingness to support environmental improvement.

**Interviewer**: So if we, yeah, if we increase the willingness to support, then we'll decrease our nutrient input levels.

**BD057**: Right, right.

**Interviewer**: Right. Okay, great. Okay, yeah so we want that as our stressor. So should we…we have kinda the benthos diversity, plankton, hypoxia, like shooting off of nutrient input, do those…do we want to leave those in the map and if we do, how do those things impact the system?

**BD057**: Let’s just say like a causal link changes biodiversity. And if you’re gonna talk about stressors, the other one is development that affects habitats.

**Interviewer**: Development, okay.

**BD057**: You could put like human effects, right, like development, nutrients, whatever you wanted to do.

**Interviewer**: Okay. So, do you want to leave that as separate or do you want to add that in with the nutrient bin?

**BD057**: Well, it should be separate I think because they have a different mechanism of destroying habitats, right, development gets salt marshes.

**Interviewer**: Okay, and so that’s the same and then what else does development impact or what else is impacted by development?

**BD057**: Healthy ecosystem, you know, I mean anytime you destroy habitats or nature, right, it’s gonna affect all this. So it would absolutely affect biodiversity, as would nutrient–that’s kind of like one of the things that we do as people is we drive biodiversity down through all of our activities. So I think whatever stressor you have there, it would absolutely affect biodiversity.

**Interviewer**: Right, okay. That makes sense. Okay, anything else? That was pretty much it for me unless anything else you want to add to the map. I’ll finish drawing out those relationships that we talked about after we get off the phone.

**BD057**: Okay, let’s see. Okay I think for maybe for development, a line there saying like direct habitat destruction. It is direct. You know as the same mechanism thing for nutrient input. Yup, okay, yeah, yeah, yeah, that’s good.

**Interviewer**: Okay, awesome. Alright, well I will stop sharing. That was like all I had but thank you so much for your time. I know we’ve already been on the phone for over an hour so I don't want to take up any much more of your time but I really appreciate it. I really enjoyed talking to you.

**BD057**: Same here. I like the way you think.

**Interviewer**: Great, some people don’t love the modeling exercise but some people really enjoy it so hopefully you enjoyed it.