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BD034

**BD034:** So, I started off - I’m an ecologist. And I started off studying the impacts of climate change on tropical forest ecosystems. So biodiversity, biodiversity patterns and biogeography, carbon cycling, productivity, things like that. And I worked in the Peruvian and Brazilian Amazon, looking across productivity gradients from east to west, and also the south. I mean, in elevation in the Andes, from lowlands all the way to treeline. And so I was doing that for like 10 years, and then I moved to Alaska and I took my research questions to the north. And so, um, there I did my phd in a population genomics lab and I was looking at the genetics of boreal forestries and how to use those signals that were in the DNA to help unpack how climate change has altered the population of certain tree species in the past. And so, I though I was going to be an academic, that’s sort of what I was just assuming that’s what I was going to do. And then, I heard about something called a landscape conservation cooperative or LCC is the acronym, and LCCs were started in the Obama administration in 2010, 2009 2010, about people working at large scales, the whole ecosystem level, together. Right, thinking that there’s more in common from different agencies and different organizations within an ecosystem than there is across that agency in other areas of the country or the world. And so I realized, at some point I realized if I wanted my work to make a difference, I would have to come out of the woods and talk to people. I think I - I think I would have been really happy to be with the trees for most of my life but I wanted to make a difference. I wanted to be impactful. And so I started coordinating that partnership and leveraging the work that I had done in climate impacts to natural systems, sort of leveraging that to think about well, what do we do. What do we do about the impacts? And so I shifted more into the adaptation field, and just partnership in general, field. Like how can we do more together than we can individually. More like a collective action or collective impact model.

**Interviewer 1:** Awesome. That sounds - wow. I would love to talk with you for this whole hour about that. That sounds great. Our um - do you know Steven Scyphers? Or have you heard of his research before?

**BD034:** No. I don’t think so.

**Interviewer 1:** He, um, a lot of his work is human dimensions of fisheries, but he’s a social ecological scientist. So I was his phd student prior to his post-doc, and [Interviewer 2] is his phd student now. So, a lot of our work is in environmental sociology and bringing people together like you’re saying to have, you know have - come up with decision making tools and better understand how people are understanding management. So your work sounds great. Sounds really fascinating.

**BD034:** Oh yeah, I’ve also been - I’m like a socio-ecological systems person as well. And one of my phd - well a committee member because he retired before he came on, and he wasn’t taking on full time students, but, Terry Chapeman. And the University of Alaska is kind of a guru in socio-ecological systems, he’s kind of a grandfather of the field. And uh, he’s kind of like a yoda. He’s small and has a beard. Like he’s really soft-spoken but when he speaks it’s like the ground shakes.

**Interviewer 1:** Were you in Juno, at University of Alaska Fairbanks? Or were you up in Fairbanks?

**BD034:** I was in Fairbanks, yeah.

**Interviewer 1:** You were in Fairbanks, got you. I just moved to Maryland from Juno, Alaska.

**BD034:** You did? Oh!

**Interviewer 1:** Yeah. Much warmer over here, much more humid.

**BD034:** Yeah, totally. I’m in New Orleans now.

**Interviewer 1:** Oh, yeah. Ok awesome. So before I dive into actual research questions, is it ok with you if I just record this interview? Just for my notes, it won’t go anywhere, but just for transcription. Awesome, thank you so much. Ok so, like I mentioned in the email I think, the really high level overarching goal of this project is to understand the functional role of biodiversity for ecosystem function and how we manage for biodiversity in marine resource management. And so one thing that we’ve been learning in this project thus far is that the term biodiversity itself means different things to different people. And of course it can be measured in multiple different ways, so as a starting point we’re wondering what you think about when you think about biodiversity and what you see as the key aspects of biodiversity.

**BD034:** Oh gosh. Yeah, I mean you could do a phd just on that. Yeah, I mean for me, from a functional perspective. You know, like I said, I work in biodiversity for my graduate stuff and it’s like, well what about alpha beta or gamma biodiversity? What are we talking about here? But I’m going to take the nerd out of that and just say like, um, for me it’s just the number of species on earth. Like it’s just the variety and number of species on earth. That’s kind of how I use it functionally in my work. And that is everything from plants and animals, to microbes, and you know, invertebrates and all the things.

**Interviewer 1:** Ok great. So some of our team’s previous research has generalized four key components of marine biodiversity in particular. So our project is focused on marine research management and marine biodiversity. And so we’re hoping to get your feedback on this framework and see if you agree that these are the key components of marine biodiversity. So I’ll put them in the chat, because personally I’m a visual person, um… oh [Interviewer 2] just did it. Thank you [interviewer 2]. Um, so they are habitat forming species, species of conservation concern, harmful organisms, and key food-web supporting species.

**BD034:** Yeah, so the question is what is do I agree that this is a four categories of biodiversity in marine systems?

**Interviewer 1:** Yeah. Are there any components that you would change or that are missing? Or we should take out?

**BD034:** Yeah, so um, I think there’s a role for ecological redundancy some place. And I’m not sure if it’s a category or if it’s folding within these four categories, just because from a management’s perspective, if I’m looking at do I dump $10 million on trying to save this species, I’m like is it ecologically redundant? Like if it goes away, would there be another species that would fill the same role? That’s kind of harsh, I guess. But it is something that when you’re thinking about resources, in some places you’re more of a triage.

**Interviewer 1:** Yeah.

**BD034:** Triage state, you know, so thinking about it a bit more, um…. I feel like there’s something missing and I’m just not putting my finger on it, you know. I’m like, what is it? I guess it’s more of a gut feeling. You know, I think there’s an aspect of like genetic diversity. So it could be at the population level - intra population diversity. Inter or intra population diversity so that it’s - if you have, you know, I said earlier the number of species, but then there’s also this idea of like genetic diversity within a species as well, is an important thing of biodiversity. And I don’t see that captured there, so that might be something to add in.

**Interviewer 1:** Ok, great.

**BD034:** It has a lot to do with how well species can react to environmental disturbance or climate change or human pressures.

**Interviewer 1:** Ok.

**BD034:** I think you could call that intrinsic. Intrinsic versus extrinsic diversity, maybe.

**Interviewer 1:** Ok. Great. Um, so I want to dive into the management part of the interview a little bit. This is a really high level question but, do you think we explicitly manage for biodiversity in US resource management and if so, in what policies and what approaches.

**BD034:** Whew, ok. I’m not the expert on this. So, do not take my word on it. I think we could do a better job at managing for biodiversity. I see it in certain places, so I don’t want to do a blanket no, coral reef management for instance is often looking at biodiversity. Both biodiversity of the corals and also biodiversity of the symbiotes. Other areas, I do not see it. At all. It’s like single species management or like in fisheries management where a bunch of fisheries are trying to manage sea birds, and it only comes in the fold when there’s a species of conservation concern. And then all the sudden the managers are like ‘oh, biodiversity’, right, but it’s never been a management target until there’s a problem.

**Interviewer 1:** Ok, yeah so, you kind of just answered my question but do you think this framework that we have for biodiversity - would you say those components are managed for in marine management in the US?

**BD034:** Yes, but not necessarily together. Not holistically. Like I think some programs will be managing harmful organisms and other programs will be managing habitat forming species, and other programs will look at food webs and stuff like that, but I don’t see often a program that’s managing all of them. There could be like within NOAA, for instance, I think you could see all of those folded within NOAA somewhere, but I don’t see it as a holistic management strategy that says - and again I’m not the expert on this. So, I could be totally wrong, but I haven’t seen a management program that’s this integrated in different aspects of biodiversity that you’ve laid out here.

**Interviewer 1:** Ok. And so, are there um, management approaches that you would like to see or that you think are needed to better manage for biodiversity in the US?

**BD034:** Oh man, we don’t know what biodiversity even means in our marine system. So I think eDNA is really important, just to try to do a… what is even in the ocean, right? There’s just so many species that haven’t even been discovered or that we’re not even aware of their trophic function or their ecological roles. So I do think that we need to focus on assessments at the same time, but we can’t wait until the assessments are done to start biodiversity conservation because that could take a while, and that could take a lot of time. People say oh, we have to do a multi-million dollar multi-year assessment and then we can’t do anything until we get the results. And I think that would be misplaced in this case because we need to do the conservation now, but yeah, you know, I’ve been lately about people doing water samples and doing eDNA off the water samples and really seeing that there’s some critters in there that we’re not really aware of yet. Or like really elusive species that we know are there, but we never see them because they’re just really really behind.

**Interviewer 1:** Right, right. Ok, great. Um, I think maybe I’m going to pause there [Interviewer 2] and we can shift to the mental modeling if that’s ok with you?

**BD034:** I’m going to get some water real quick.

**Interviewer 1:** Ok, yeah.

**BD034:** Alright I’m back.

**Interviewer 1:** Great. So have you ever heard of this software called Mental Modeler or Fuzzy Cognitive Mapping?

**BD034:** Yeah. I’ve heard of it, I haven’t played around with it.

**Interviewer 1:** Ok. So, for the second part of the interview, what we’re hoping to do is build a mental model with you of how you think of biodiversity. So while you and I have been chatting, Sarah’s been building a concept list in the background, and then I’m hoping that we can finish drawing this map.

**BD034:** Cool.

**Interviewer 1:** Sounds like you already know. But basically, a mental model is a way to conceptualize how an individual thinks about a system, and so you start by building a list of the system components, which we have here, and then we can assess how those components are related to one another. And so, to start first, [Interviewer 2] do you want to go through the list of concepts? And then you can make any adjustments as you see fit.

**Interviewer 2:** Ok. Yeah, so the gray concepts in the middle are those four bins that we identified and then you added ecologically redundant species as the fifth one. And the orange concepts up in the top left are things that you’re thinking about when you think of biodiversity, and then the blue are current management that may consider biodiversity, and the yellow is policies that should be incorporated, or more time should be focused on that to encourage biodiversity management.

**BD034:** Cool.

**Interviewer 1:** So do those concepts look good? Do those accurately reflect what we’ve been talking about so far? Are there any changes we should make?

**BD034:** No, I think it does accurately represent it. I never did this by myself, like I always do this with a group of people, and so it’s like what am I missing without a whole group of people adding things? It’s interesting.

**Interviewer 1:** Um, ok great. So, what we’ll do is we’ll go through each concept and I’ll ask you if that system component was to increase, would it have an impact on any other system components. And if you do see a relationship between two components, I’ll ask you if it’s a positive or negative impact. And we can also, if we want, if we have time, we can add weights to the relationships, and those weights are relative to each other to determine which weights in the system are driving the system dynamics. So which relationships would have a low, medium, or high impact. Sorry what did you say?

**BD034:** Ok, just remind me as we go through. Yeah, I think for ecologically redundant species, I think I might - that’s how my mind went into this, but I think in this case, with your four categories, it would be more like functional role, or like functional ecological role. And then some of those roles are going to be redundant, but thinking about how you explained we were going to do that, I think that would make more sense then… yeah so ecological or functional role.

**Interviewer 1:** Ok. Ok, great. So, maybe let’s start - I’m trying to see what’s a good one. So I think um -

**BD034:** Oh and then one more thing too is um, maybe it - maybe we condense it into functional role of species but put species and communities. Because I think it’s more than just a species. I think it could be an assemblage of species. Sorry.

**Interviewer 1:** Oh no, please. Um ok, I think ecological resilience is a good one to start with. So, if ecological resilience was to increase, would that impact and any of these other concepts?

**BD034:** Yeah, I think it would kind of impact all of them in a way. Um… yeah I can’t think of anything that it wouldn’t. It’s just kind of a broad stroke.

**Interviewer 1:** Yep, yep. Ok. Ok, do you want to pase there [Interviewer 2]. So would, would any of those relationships be positive or negative? Can you assign a sign to each of those relationships?

**BD034:** Oh jeez. Um, It’s so context dependent. I think they would all be… well it’s hard to say. Harmful organisms, for instance, in one way the diversity of harmful organisms would be positive because you’d have more harmful organisms. But in another way, it would be something that is harmful to - if it’s harmful because something is off balance, I’m thinking like red tide, like the gulf hypoxia region which is really big in my neck of the woods, some of those would go down. And in other cases it would go up. Because like, if you’re talking about Portuguese man o'war, there would probably be more of them. So, yeah. I think that one’s context dependent. But I think they’re mostly positive.

**Interviewer 1:** Ok. Yeah, for the ones that are context dependent, we can just leave them as a question mark there. Usually what we do when we do mental modeling is - you just gave a purpose example of red tides versus Portuguese man o’war. We would separate out harmful organisms as a concept as a species, so we could draw out those positive or negative relationships.

**BD034:** Yeah. And harmful to what? Harmful to who? Is also something we would need to separate out I guess.

**Interviewer 1:** Yeah. So we can specify any of these things as you see fit. We are building a pretty broad generalized model here, so that’s why I don’t think we need to bring in the specific species necessarily, but if you want to clarify like, harmful organisms to what, we can separate out categories if you’d like to.

**BD034:** Um, I think it’s ok for now. I guess if it keeps coming up we can do that.

**Interviewer 1:** Ok. Is there anything else? We have ecological resilience connected to the other biodiversity components, but would an increase in resilience impact the management concepts in blue or are… the yellow are also management, right [Interviewer 2], but they’re future approaches?

**Interviewer 2:** Yeah, like policies that should be considering biodiversity.

**BD034:** Right, yeah. So would ecological resilience impact coral reef management or single species management?

**Interviewer 1:** Yep.

**BD034:** Yeah, definitely.

**Interviewer 1:** Ok.

**BD034:** Both of those in a positive way, I would think you would need less manipulative management? Or like, um… what’s the word I’m looking for. I just got back from a conference this week so my brain is totally mushed out. Uh, what’s the word.

**Interviewer 1:** Like less regulations? Or…

**BD034:** Active management. You would need less active management.

**Interviewer 1:** Ok, so I think so, what can… um. The thing that is always challenging with mental modeler is we say positive or negative, but mathematically it’s an increase or decrease. So if that would increase, there would be a need for less active management. So it would decrease.

**BD034:** Yeah, it would be negative.

**Interviewer 1:** Yep, ok. Sorry, I probably explained that poorly. We always got through that a million times. Um, ok. And then would ecological resilience impact eDNA or biodiversity assessments?

**BD034:** Not directly, I don’t think. Because those are more information gathering. I mean it might impact your results, but I don’t think it would impact the technique at all. How you would approach it isn’t in that relationship.

**Interviewer 1:** Ok, great. And… I think maybe - so I’m going to ask, but it’s ok if we can’t do it. I mentioned it in the start but we can also assign weights to these relationships, and so for each relationship we can assign if it has a low, medium, or high impact and that just helps us understand which relationships drive and are most important to system dynamics relative to one another. So, do you think based on this first set of relationships that that is something you could do? Do you see a difference in impacts of the relationships?

**BD034:** I think that the species of conservation concern would have a higher impact and um… yeah. So I think I would give high to species of conservation concern.

**Interviewer 1:** From ecological resilience?

**BD034:** Yeah. Um, and then… well, now I want to give everything a weight. But I think - yeah, I’ll give that high and then everything else can be the same. So I guess the rest can be medium.

**Interviewer 1:** Ok.

**BD034:** Not to say that I think everything is going to have a medium impact, I think that the biggest impact would be on species of conservation concern.

**Interviewer 1:** That’s perfect. That’s exactly what we want to represent. That it’s just relative to one another.

**BD034:** Yeah, just relative, right. Oh, and you’re doing those too, let me look at those. I didn’t look at the orange ones.

**Interviewer 2:** Sorry.

**BD034:** I just didn’t look at the other ones, sorry. I think that extrinsic diversity and intrinsic diversity are subsets of other species, like those are all related to each other in a way, they’re kind of a group. And that ecological resilience would impact all of that. So, like, I would give that high as well.

**Interviewer 1:** Ok, anything - so we have. So [Interviewer 2] you made everything on the right side, right.

**Interviewer 2:** Yes.

**Interviewer 1:** Ok so would - so ecological resilience to coral reef management and single species management. Like, would you leave those high as well? High impact?

**BD034:** Definitely for the coral reef management. And then single species… I would keep it medium like the other ones. I feel like it’s important but here would be other ones that you would want to call out as being the most important.

**Interviewer 1:** Ok, sweet. Um, so let’s just check. So we have coral reef management and single species management as both impacting species of conservation concern. Were those - I think maybe those were relationships that you drew, [Interviewer 2], prior.

**Interviewer 2:** Yeah so the impacts of different management on species of conservation concern and habitat forming species - I took from what you were mentioning earlier. Corals are both habitat forming and species of conservation concern, but if you only see it one way we can definitely take something out.

**BD034:** No, I would keep it both. The rest I would keep - the web supporting species in many cases. And then single species management, yeah definitely species of conservation concern. I would link single species management with key food-web and also with harmful organisms.

**Interviewer 1:** Ok. So, would having more active management, single species active management, would that increase or decrease harmful organisms?

**BD034:** Decrease. I just came from this concept where I heard a lot about like feral hog removal. Something like that’s a harmful organism because it’s an invasive species and tearing up the habitat for important birds and other species.

**Interviewer 1:** Something I would never think about as a harmful organism in my line of work.

**BD034:** I know! And I probably would have never thought of it either until I learned more about it then I ever thought I would. I was in Texas in Corpus Christ. Well, feral hogs dig up sea turtles and all the nests.

**Interviewer 1:** Oh… I think I saw a feral hog when I was in Mobile, Alabama. Do you guys have that [Interviewer 2]?

**Interviewer 2:** Yeah. Yeah, they’re a big problem down here.

**Interviewer 1:** Ok. Yeah I saw one on the side of the road when I was driving with Steven, and he almost pulled over because he was so excited. I swear! I really think - I mean maybe I was making this up, but yeah. There was a big pig on the side of the road.

**BD034:** That’s cool. Yeah, I guess um Ponce de Leon and his crew in the 1500s brought pigs because they wanted to eat them and have them for other species to eat and they’ve done quite well and proliferated.

**Interviewer 2:** It’s the same with nutria too. The conquistadors brought them over.

**BD034:** Yes.

**Interviewer 1:** Um, ok great! Um, alright so… maybe let’s finish off the coral reef management and single species management while we’re there. Do either of those impact anything else?

**BD034:** I would - coral reef management probably impacts functional role. Yeah, it just depends on the management but I could see that be the case. For that impacts. I don’t see a lot of harmful organism groups, I’m sure it exists but I can’t think of an example.

**Interviewer 1:** Ok. And, what about the relative impact of management. Of those relationships. Are those all low, medium or high? Or do they vary?

**BD034:** For coral reef… I would say habitat is high, food-web is high, and species of conservation concern is high.

**Interviewer 1:** Ok. I think - is that all of them? Ok.

**Interviewer 2:** The functional role?

**BD034:** Yeah functional I would say medium or low. Well no, medium.

**Interviewer 1:** Ok. And then for -

**BD034:** And functional role for things like photosynthesis and right? Like, even though that’s just part of the food web but there’s just a functional role there as well.

**Interviewer 1:** Great. And then for the single species management?

**BD034:** We have that one. Food-web and species of conservation concern. Is that the only ones that we have?

**Interviewer 1:** And harmful organisms.

**BD034:** And harmful organisms. Well sometimes, I think we probably should have a link to habitat forming species as well. Sometimes single species management is targeted at habitat forming species. I think that that’s less then - I would give a higher priority to species of conservation concern for sure. And then… yeah I’m just going to keep it at that. Like that you really see it.

**Interviewer 1:** Ok.

**BD034:** Well, high medium or low right, we can’t give like high .5? I’m trying to like cheat my way out of this. I’d say habitat forming species is high as well.

**Interviewer 1:** Ok. You technically - it’s a scale of 0 to 1 so we do sometimes do ask on a scale of 0 to 10 but it gets really nuanced. So we usually just keep it low, medium, and high.

**BD034:** I mean I’m just like… single species management is mostly done for species of conservation concern. That’s the time it’s mostly done. There are some other cases where single species management is done for the habitat or the food. What I’m thinking of is gopher tortoise, for instance, in the south east. Species of conservation concern, some populations are on the endangered species list, and also makes homes for a lot of indigo snakes and other critters. That’s another reason why gopher tortoise is on the endangered species list. And they’re not managing it just because they don;t want to see the sea turtles disappear, even though that’s part of it -

**Interviewer 1:** It has an additional role.

**BD034:** Because it provides an ecosystem service.

**Interviewer 1:** Gotcha. Ok, that makes a lot of sense.

**BD034:** I’m sure I could talk my way into every single one of those.With examples and stuff.

**Interviewer 1:** Um, ok maybe it would be good to go down the eDNA and biodiversity assessment because I feel like those are in a similar vein to the management concepts. Um, so, when we say eDNA are we - is that concept sufficient or is there a way to change it to management? Like eDNA data?

**BD034:** Yeah, and it’s a type of assessment right, so those are linked. Or categorized. So biodiversity assessments, one way to do a biodiversity assessment is through doing eDNA so I don’t know if those two things are separate.

**Interviewer 1:** Ok. Um… because you’re saying eDNA falls under the umbrella of biodiversity assessment essentially?

**BD034:** Yeah. Yeah, that’s what I think. eDNA could be used for two things. Assessment and monitoring. And so, I think we should add another yellow box that’s biodiversity monitoring. Um, and eDNA is a tool that you would use - it’s one way to do both assessment and monitoring.

**Interviewer 1:** Gotcha.

**BD034:** Assessment meaning the - assessment’s kind of like what do we have here right now in this present moment. And monitoring is looking for changes over time. Patterns, trends.

**Interviewer 1:** Yep. Yeah that looks perfect [Interviewer 2]. Um, ok. And does - so, more eDNA data. So, would that have a low, medium or high impact on monitoring and assessment and would it be positive or negative?

**BD034:** I would say high and positive. I’ve seen it in action, it’s pretty phenomenal. Especially with invertebrates and microbes.

**Interviewer 1:** You know, I’ve heard so much about it but I’ve never seen it in action. It still seems very mythical to me.

**BD034:** It does. It does, but it’s pretty phenomenal that you can just take a sample of water or a sample of dirt or something and figure out what lives there. It’s pretty awesome.

**Interviewer 1:** Yeah.

**BD034:** And then - you know I almost want to put like… I think what sometimes is missing from management around biodiversity is I think there’s a role for the fossil record to play. And I don’t mean fossil necessarily by hard fossils. That’s included but like, paleorecord, is what I’m trying to say. And so… because there is a piece that I think that biodiversity management does not take into account as often as it should is what things - where things were in the past and how they’ve changed. How they’re related to different environmental variables.

**Interviewer 1:** Yup. Ok cool.

**BD034:** And so understanding how communities change, how species changed over time in the past, and then modeling that into the future is something that…. You know people do that all the time, but they’re usually academics. They’re not managers.

**Interviewer 1:** So how would - I guess, so paleorecords. How would more of those records impact the other components.

**BD034:** Like in the gray boxes and things?

**Interviewer 1:** Yup.

**BD034:** Um, so I think it would - I’m going to go with the management first. I want to put a link to both management - to both single species and coral reef management from the paleorecord. For instance, if the paleorecord shows that certain coral reef assemblages existed like during the cretaceous when it was really hot, and there was a lot of carbon dioxide, then we might say oh can we try moving some of those species to a certain area now that it’s going to be really hot and have a lot of carbon dioxide. Maybe look for more species that have more tolerance to that kind of environmental conditions. And then same thing for single species. Like are there species that have, that are not going to make it. And so we’ve got to do special things like putting them in a seed bank or something, you know, because we see them being locally excavated. And those things. So same conditions.

**Interviewer 1:** Ok. Would paleorecords impact anything else in this system?

**BD034:** Ok let me think. I haven’t gotten that far ahead. Not except that I was really into that functional role and then now that I have - now that I’m going into this I’m kind of like well that’s habitat, key food-web so I don’t know if we actually needed that one after we spent all that time trying to nail it down. But um… so yeah. I think that species of conservation concern is the same thing as single species management for the reasons that I just mentioned. Um, for ecological - I think it would impact ecological resilience. I think it could help inform our idea of what ecological resilience means in a system. If we can look at how a species changed through time, then we could have a better understanding of ecological resilience. Uh, yeah. The other ones are just kind of… I wouldn’t say they’re impacted. I mean it’s all related, you know, but to me it’s not as strong as a relationship. So you could either put lines to all the other ones, and then just put them low or medium if that’s what you want to do. Or not at all. I don’t know how your analysis is going to impact - I think that paleorecords could inform key food-web species, but I don’t think it’s as important as species of conservation concern or…. Let’s see. Let me just think through that before I say that. Uh, yeah. Do the functional. Do the paleorecords to the functional and single species communities because what I was trying to think with that is like… habitat and key-food webs are two examples of functioning, but I was really thinking of you know, like different assemblages and the interactions among species. So those interactions then - you know, I’m thinking about so like with habitat forming species, that’s interaction among species, but it’s very specific. It’s a very specific type. But yeah, definitely correlated.

**Interviewer 1:** Ok. Ok. Um, ok. So to go back to the other relationships between paleorecords, you’re saying that paleorecords help inform - would those records directly impact those species? Or would they help inform management of those species.

**BD034:** I guess inform management.Yeah. Maybe that - you could delete that.

**Interviewer 1:** Yeah, so then it would be an indirect link through management.

**BD034:** Yeah, so the one for the species of conservation concern, you can move that too. It’s just definitely the management. So yeah, thanks for helping me figure that out.

**Interviewer 1:** Ok, yeah. Great, ok cool.

**BD034:** And so then the biodiversity and assessments and monitoring, put them also as informing management.

**Interviewer 2:** I’m sorry, say that again please.

**BD034:** Uh, the biodiversity assessments and the biodiversity monitoring can be linked to single species management and coral reef management. And there’s other types of management that we don’t have on here, like fisheries management - I don’t know why I said coral reef specifically. But you know, I’m sure there’s a lot more blue boxes we could put in. If you guys find that useful. Or we could just go with what we have since we’re running low on time.

**Interviewer 1:** Um, yeah. Maybe because we’re - we have like 15 minutes left. Let’s see what we can draw out and if we have time we can add some of those things. Does that sound good?

**BD034:** Yeah.

**Interviewer 1:** Ok. So, I think let’s try to just finish out the orange ones, maybe, next. Because I know you said number of species on earth and then intrinsic and extrinsic diversity are kind of together, are those redundant or are we leaving those as three separate concepts?

**BD034:** I think we could put a link, like we did for eDNA. We could put a line underneath towards intrinsic and extrinsic.

**Interviewer 1:** Ok. And then… so does that look good? Intrinsic and extrinsic? And then for number of species on earth, increasing that concept would that influence the other system components?

**BD034:** Oh I think it’s going to be a positive relationship with all of them. With all the categories of biodiversity. Including harmful organisms. I would think it could, it would just increase everything right? Is it harmful to the people, is it harmful to whatever, like to things that like to eat people, predators…

**Interviewer 1:** Yeah, that’s part of what we’re trying to do. Along with getting feedback on the actual components, but actually helping build definitions for them. So, we’re interested in what you think a harmful organism… like what that is for you I guess. Because people have different opinions on it.

**BD034:** Yeah, I mean, I don’t - because I have some background in paleoecology, that’s why I brought it up. I don’t think about it much these days, but I’ve - from the paleorecord we know that species have large scale migrations. Like the boreal forest that I studied in Alaska, for my phd, during the last glacial maximum 18, 20,000 years ago, it was in Virginia. For me, like dandelions where people are like ‘that’s an invasive species’, you should not hate it just because it’s successful. It’s just doing what it does, and it’s actually good at it. But for me, I mean I guess we’d have to find out is it harmful to humans, is it harmful to, um, you know I think we have to set some more sideboards on that before I can answer but I think there’s categories. Like, you know, directly harmful, poisonous vipers that bite you and you die in like 15 minutes. Like, is it harmful - I would call that a harmful species to people. But then there’s also, you know, species that just offset the balance of ecological functioning or economic opportunity.

**Interviewer 1:** Yeah, ok.

**BD034:** Yeah. We could - that’s a master’s project right there. How do we define harmful species?

**Interviewer 1:** Ok, yeah. Fair enough. Yeah, we get that a lot in our interview questions. That they’re a little overwhelming. Ok. Is there anything else that we need to connect from number of species?

**BD034:** It’s connected to ecological resilience already. Um, so earlier I was wanting ecological resilience to number of species, but I think it could be a two way arrow. I don’t know if you could do that.

**Interviewer 1:** Ok.

**BD034:** Um, I think it would impact the management options. And, I don’t know if I could give it a direction. Like if it’s a positive or a negative? Because I think that’s really context dependent. Because sometimes with a species you need more management, sometimes you need less management. So I think it’s really context dependent. Like with coral reefs, I would say the more species you have the less management you would need, and maybe? Like that’s a first thought, I haven’t thought that deep into it. I’m thinking if you have that first species, you have a better chance of species being able to - you know, if you have a certain disturbance regime going on, you have more species there then you have a better chance that more species will survive and there’s less need for management.

**Interviewer 1:** Right. Ok.

**BD034:** That’s kind of the classic community ecology example isn’t it?

**Interviewer 1:** Ok, um. Are any of those relationships from number of species on earth, so we just have them set to one, to high impact - are there any changes we should make to those weights?

**BD034:** Say that again?

**Interviewer 1:** So all the relationships we just drew coming from number of species on earth, would those all be… is there variance in their impact, yeah. If there’s low, medium, or high impact.

**BD034:** Oh, look at that! That’s really helpful. So, are the ones that are going to the management ones, they’re gray and not as thick. What does that mean?

**Interviewer 1:** Those are the ones that you just said were context dependent. So if we can’t assign a sign to them, saying whether or not they’re positive or negative, then they’re a question mark.

**BD034:** Oh ok, that’s right. We talked about that at the very beginning. Ok, so are any of these high medium or low… no I don’t think so.

**Interviewer 1:** Ok, so leave the… we had left the ones before.

**BD034:** Yeah, they’re all the same. I think they’re all high, is what I’m saying.

**Interviewer 1:** Ok, so leave the high. Ok. So then, I think our - we haven’t gone, we’ve connected everything to the biodiversity boxes but not from. That’s our last thing. So I know we don’t have a lot of time, but…

**BD034:** My head just turned on my shoulders when you said that. Like we have to do all of that still? In 6 minutes? Um. Ok so all of the boxes to the number of species on earth, yes. That would be high. Yes. Yes. Uh, yeah. We already did ecological resilience both ways, so um, it would be really cool to tease out extrinsic and intrinsic diversity and how that might change depending on which one you’re talking about. And again, intrinsic being like within the diversity within a species, and extrinsic being between species Being different species, and then intrinsic is within a species. But um, yeah we don’t have time for that.

**Interviewer 1:** Yeah. Ok. In our last five minutes, are there any other really important relationships that you think are missing? Do you want to maybe, [Interviewer 2], highlight the gray boxes so we can see what’s coming to and from them?

**BD034:** You know, thinking of my… trying to coordinate my thoughts here. But it’s a deep one, and I’m like yeah, this is going to take me a minute. But I can do it in four minutes if I believe in myself. There is… there’s a piece. So we’re thinking about biodiversity within life on earth right, it’s like how I think about it from the very beginning. Life on earth. Yeah. I’m just - i’m trying to yeah. There’s something… I think what I’m trying to get out would probably come out if we did the blue boxes with different types of management, but it’s like - so the two different types of management we have, we have coral because we love to take care of coral and we want to see them persist. And we’re taking care of species because we want to see them persist and that’s worth it. And I think there’s a thing, that if we were to do this for another hour that I would want to delve into how, you know, agricultural - and I know that this is for the marine, like fish farms, aquaculture. You know, how we manage for species because they’re economically valuable. Fisheries, aquaculture, port storage, sequestration… things like that. If I just looked at this map as an outsider, I would think that there’s something missing. Like, this is more of the intrinsic value on it’s own, and I think there’s a role for saying that biodiversity is really important for our economy and our human society that we manage for it because we like that, not just because we like it.

**Interviewer 1:** Yeah. Are those - are there any other specific management approaches that you think it would be really important for us to know about? Not that we would add to the map obviously, because we have one minute, but just like….

**BD034:** Well even like tourism. And recreation I think should be in the list. I mean obviously there’s like fisheries management, as a food source, but then there’s recreation and tourism and yeah. I think there could be - I mean it’s multi-faceted for sure. And then like for food source, if you really wanted to geek out you could go like commercial food source versus more of like a subsistence. Like catching fish to feed their families and in Alaska it’s a really big deal that a lot native people can harvest salmon in different ways. That they get a lot more salmon than other people because it’s a subsistence lifestyle. Versus catching salmon out to ship to New England for people’s salad. It’s species management, but much different. It’s the same species but being managed much differently for different use by people.

**Interviewer 1:** Yeah, ok. Well…

**BD034:** And you know that from your time in Juno.

**Interviewer 1:** I do. I am a vegetarian, I never eat fish. And right before I moved, I was like I should really try salmon. And my friend had caught fresh white king salmon from Yacatat the day before and she flew to Juno and I had it and I hated it. And she was like, don’t tell anyone that you hate this, and if you hate this then you don’t like salmon. And you don’t like fish.

**BD034:** Yeah, I’m like a salmon snob now from being in Alaska. And I’m not a big fish eater.