[Interviewer] 12:01:21

Before we kind of jump into our specific interview questions, we were hoping that you would tell us a little bit more about your area of expertise in your current research.

[BD012] 12:01:39

Sure. Yeah, I'm kind of a generalist marine scientist, but I tend to focus on coastal fisheries. I deal with habitat, and you know, also anthropogenic disturbances to those habitats, whether it's climate change or other kinds of disturbances. So, my work right now tends to be a lot on salmon, although I've also got projects on jellyfish and herring. So I'm not just a salmon person, but I like to think kind of more generally about marine systems, interactions, and how changes in those toxicology are influencing other parts of the system in my research program. I've got - yeah. So I'm mostly working on salmon and the marine environment. I tend to not go into fresh water at all, so that's the line drawn, but I have been working on a large scale project on the cumulative effects of restoration for juvenile Salmonids. So that's one big project right now and then, like I said, I'm finishing up a project and that was related to how bird populations can basically drive down per pre availability for outbound migrating juvenile salmon. So that's kind of another one. They're sort of all salmon oriented.

[Interviewer] 12:03:05

Very cool. I saw the state of the salish sea report that you've been working on. Would you mind telling us a little bit about that in your work?

[BD012] 12:03:16

Yeah, sure, so yeah, I actually took that project on as a contract when I was kind of in between a postdoc, and not really sure what I was doing next. I applied for a few jobs and I was sort of waiting for something to land. And it ended up being like an enormous body of work, so I wrote this state of the salish sea. I’ve got a nice glossy copy right here. So it's very - It's like several 100 pages. It was thousands and thousands of words. And yeah, it was through the Sails, the Institute here at Western, and we had an advisory committee, but it was kind of up to me to decide how I wanted to do it. And they said, Yes, or no, essentially, like, Yeah, I think that sounds like a good idea or not. So it was a little bit of a science overview. Most of it is on, like, sort of the state of what we know about science and the salish sea. And I've used 2 kinds of focal themes. So one urbanization and then one climate change. So urbanization is kind of like local impact, right, where climate change is sort of happening everywhere. But the confluence of these 2 things is making it, you know…sort of the confluence makes the situation worse in a lot of places, right? Because you have urbanization. That's taking out the habitat, bringing in storm water that's filled with contaminants and stuff, in addition to sea level rise and lost habitat from that. So, yeah, so that was the focus. And then the end part of it - my collaborators at the Sail Institute helped with that, which was kind of like the next steps. Where are we headed? What are the major gaps in research, like what sort of trans boundary - because this is an international ecosystem and it's like changing as I was writing this. It's absolutely shocking how much just stops at the border, and how much, you know these, you know, different units of even census data, like trying to get an idea of population in this region and the geographer I was working with was like wow I had no idea it was going to be this far. You know, there's just this, like, data harmonization thing. So a lot of the end steps focused on like what you know, what that would look like in terms of trans boundary science to try and scale the science to the ecosystem rather than to political boundaries, and then something that Emmett may or may not know about is I kind of worked with a couple of other scientists in the region, kind of at Friday Harbor Labs and Uw. to write a paper in Elementa that was published, I think, in December, and so that was kind of a spin off of this.But like thinking about how the lessons learned through the writing of this report might also be applicable to many urban seas and like coastal Urban Coastal ecosystems. You know those of us working in estuaries, our careers are acutely aware of this, but I think, like a new name, and some new phrasing actually might… I see it as a benefit, because I think people aren't really working about or thinking about urbanization and how it impacts marine waters because it's like the seascape versus the landscape. But yet there's a lot of impacts that flow downstream. So that's coming. Maybe that was more than you needed?

[Interviewer] 12:06:09

Oh, no, that was great, and I really look forward to looking at that publication you're talking about. And I won't go into too many details right now, but part of this project that will be kind of our secondary phase is we'll be doing 3 case studies, and one of them is in Pacific, which is in part what we're going to talk to but then we'll be going to the Northern Gulf of Mexico and then we think our third will be Chesapeake Bay, but we're still figuring it out. But I - there'll be a lot of similar themes to what probably is in this manuscript, and we can probably learn a lot from your work to inform our different case studies.

[BD012] 12:06:43

Yeah, and actually, I mean, interestingly, Chesapeake Bay was one of the systems that we looked at for comparison. And this like kind of in the element piece, in the Pacific. We do a few examples from the Pacific as well, like in more established urban seas. And then the cumulative effects project that I talked about that's actually really closely tied to the Gulf of Mexico work that - I have a report somewhere. I'm not sure where it went, but some of this Robert Twilly and others were working on, related to assessing cumulative effects of restoration there. So we've taken that and kind of - it was a National Academy's publication, and we've taken that, and now we have made some new methodology for that. That's kind of a cool tie as well.

[Interviewer] 12:07:27

Cool. Okay, that -

[BD012] 12:07:29

Let me see if I can find that stupid thing. It's this one. Have you seen this?

[Interviewer] 12:07:37

I don't know if I have.

[BD012] 12:07:40

It's like a National Academy's consensus study report. And I think, yeah, it's available online. Holly Greening was the chair of the committee, and then there's like a whole bunch of other people on there.

[Interviewer] 12:07:52

Okay, I think that I'm sure that Steven, [Interviewer 2]’s PD advisor knows about this. Robert, I think that he might be on a National Capital Committee, that Steven was just appointed to.

[BD012] 12:08:07

Actually, I had the wrong name. It's Boyton that was on this one. I think I was thinking Robert Truly, because yeah, anyway, I had that wrong. The wrong person. But yeah, there's a - I can send the link afterwards if you want.

[Interviewer] 12:08:24

Yeah, that would be great. That'd be super helpful. Thank you. Okay, great. So then I'll jump into our more formal research question.

[BD012] 12:08:34

Sure!

[Interviewer] 12:08:39

So as I'm sure you saw in the email, I think we put in there and then, you probably know. The goal of this project, really broadly, is to understand the role of biodiversity in marine resource management. And so the first phase, and why we're hoping to talk to you today and why we’re talking to some other experts, is to understand how researchers and managers perceive and conceptualize biodiversity and understand what management approaches currently use a biodiversity approach, and then what management approaches we need in the future to better consider biodiversity when we're managing these resources. And so, as a starting point, we know that the term biodiversity means different things to different people and can be measured in multiple different ways. And so we're hoping to know what you see as the key aspects of biodiversity and what you think about when you think about that term.

[BD012] 12:09:30

Yeah, I mean, I think of it as the, like, assemblage of taxonomy of a specific place. And when I think of biodiversity, I think like we as scientists, we tend to focus on one or 2 species right? But I think, like, of the importance of it is that it's helping to stabilize ecosystems in a broader way right? There are always these trade-offs. Populations rise and fall, and this sort of accumulation of taxonomy helps stabilize a system in those in inevitable populations, rises and fall, rises and falls - I don't think that's right, the proper grammar, but yeah. So I think it’s not just, like, the number of species, but also their population. So to me, there's a population part implicit in that. Just, like, which species are there?

[Interviewer] 12:10:29

Okay. Great. Okay. So for this project, we focused on generalizing biodiversity into these 4 key components and we'll put them in the chat. I don't know if you mind doing that.

[BD012] 12:10:45

Okay.

[Interviewer] 12:10:48

So they're in the chat, so you can visualize them. But they are habitat forming species, species of conservation concern, harmful organisms, and key food web supporting species. And so, we're wondering if you agree that those are the key components of biodiversity, and if not, what you might remove, what you might be missing, or what else you personally consider in your research and work.

[BD012] 12:11:13

What is harmful organisms?

[Interviewer] 12:11:15

It is whatever you think it is in this case. I mean, people - people have brought up lots of different examples. And yeah, I mean organisms that harm the ecosystem is how I would just say it broadly, but I'm hesitant to give specific examples of other people have gave because we're interested in your perceptions of what these components are, I guess.

[BD012] 12:11:39

That one kind of sticks out to me as an oddball, like…

[Interviewer] 12:11:41

Okay.

[BD012] 12:11:43

I'm not really sure, harmful to who? Or what like that it seems a little vague and yeah, they're always gonna be organisms even in like the most pristine setting that are maybe harmful to one thing or another. But I'm not sure. I'm not sure I agree with that in this list of what these are. So yeah, I mean, if we're talking about, like, ecosystem services, and it’s really human centric, I could see that. But that wasn't the framing that I kind of took from you. So I think habitat forming species, pieces of conservation concern…of course those are the ones our policies are written for, and then key food web supporting species. But I think we're missing all the other ones right? There are also other species that maybe we don't pay any attention to, but that are having some supporting role, in stabilizing and making the ecosystem function. I mean we have barely looked at microbes. So that's the one that kind of jumps out to me, right?

[Interviewer] 12:12:42

Okay, that's perfect. So for the next few questions, we're hoping to hear a little bit more about your specific work in the Pacific. Since that's going to be one of our case studies. So this’ll help inform how we'll proceed forward with that case study when thinking back to that, you know, bigger picture research question. We're looking at what management approaches currently consider biodiversity. We're wondering specifically in the Salish Sea and in your research and experience, are their management approaches that currently explicitly consider biodiversity, and if not, what approaches would you like to see in the future to do so better?

[BD012] 12:13:26

Yeah, I mean, certainly, there’s a lot with species of concern. So of species of conservation concerns. I think our management is largely driven by those in terms of biodiversity, and the supporting habitat species that support those species of concern, so that things like illgress and and like those primary producers who we now are realizing are, you know, kind of critical to this ecosystem. Working and buffering climate change, and all these other things. So in Washington State, we have fairly good policy, especially, like, with respect to kelps and seaweeds, or kelp seaweeds and sea grasses. In BC, It's a little bit different. So the way things are managed there - I'm not an expert on BC policy, but through the writing of the Salish Sea report, I definitely understand that there are vast differences in how things are managed. So like, in the Department of Fisheries and Oceans, there are, like the main things in the water column. They do plankton. They do fishes, they do whales, but they don't do anything that's attached to the bottom, so that - it's like really really piecemeal who works on that. The park service does some of like the conservation - ECCC, environmental conservation, climate change, Canada, or something like that.

[Interviewer] 12:14:47

Okay.

[BD012] 12:14:47

The triple C, whatever that is, they manage some of it, if it's in certain areas. So that more piecemeal approach to policy, I think in Washington we're at an advantage because we sort of take these things all as a whole, and they're managed as they are. So in terms of how biodiversity plays a role in policy, I think you know… you know, you have to think about this cross-border cross boundary thing, and they're going to be the generalizations. Like we'll stop a little bit of the border, I think, just based on my experience, but in terms of biodiversity, I mean, it's very much specific, I think, like we don't have an organization in this state that's like thinking about marine species, right? It's like we have DNR, Department of Natural Resources, in Washington that are thinking about the Kelps and seaweeds of things on the ground. And then we have DFW. Who's all no, we have enough overlap, I think, here. We're kind of getting the biodiversity through the overlap of our management agencies. If that makes sense.

[Interviewer] 12:16:02

Okay.

[BD012] 12:16:03

Did I answer that question? Because I feel like that idea of, like, biodiversity as a policy goal is very fuzzy to me personally, like…

[Interviewer] 12:16:04

No, that’s great! Yeah, yeah, that makes sense. Okay, so when you say the biodiversity is very specific in management, that's both in Canada and in Washington. But you're saying that in Washington, there's another - the bases are all covered across the agencies essentially, and they work together well enough that together it's, it is considered. But Canada…

[BD012] 12:16:31

Yeah, I, think I think they're struggling more with how to incorporate habitat forming species. So like oyster reefs, things that are on the bottom… like, do they incorporate that into their fish layer or other, like, higher trophic layer? You know, management - DFW does, they manage the fisheries and that's fine. But you know, when we're talking about like urban coastal systems, it's this interface. Like basically, one kilometer from the shoreline in interior and out to the ocean, that's like really the critical area, right. And so we're thinking about what's happening right there and then of course our river system is delving far beyond that. But, like, sort of this urbanization tends to occur right on the shoreline, and, like, within, let's say, 5 kilometres.

[Interviewer] 12:17:17

Got it. Okay.

[BD012] 12:17:17

So the yeah. So I think, here, yeah, I think that's right. I mean, we tend to be, you know, just by necessity there are regulatory structures for our marine mammals, like, right, our migratory birds, or whatever. We can take them as a whole but it's not encompassing, like not all the birds are all like mammals. And it’s like, the mammals are not all like the other mammals. I feel like the Marine Life Protection Act is - like, I'm learning a few different things. It's like a very, very strong policy, like it is very hard to get some sort of waiver from that policy.

[Interviewer] 12:17:52

Okay, so are there other approaches? I know you talked a lot about, you know, how we need a transboundary approach with Canada and Washington working together on these issues and having more consistency across their management approaches. Are there other approaches that you would like to see, or you think would be useful in using more of a systems perspective to consider biodiversity?

[BD012] 12:18:16

I think, beyond biodiversity, I think some sort of ecosystem aligned management would go a long way right, and that like from the science side, we can accomplish that through private funding. That's not - that doesn't stop at jurisdictional boundaries, right. So if I get funding from the State of Washington, they don't necessarily want me going up and sampling in Canada. I’m saying, if DFW’s funding Canadian scientists, they don't really want them to extend their survey down. There are a few exceptions. There's some overlap, but I think this is one of the things that I really dove into in the Pacific, in places like San Francisco Bay. And in Chesapeake Bay, that don't have these - they still have these State boundaries that maybe aren't as firm aligned, but they still… things are done differently in Maryland than Virginia. Right? So the way it is managed is, like, still a little bit different. But the Pacific was a good example, because that is international, and they have, like, kind of a science board, I think, this committee that does like… it's in - It's in the paper. I reference it in there. But it's like, basically a convening body that helps set the science agenda for the region. So it's not just for biodiversity, but and I feel like we could use a science board here in the Salish Sea that's thinking of the ecosystem scale, not just at the State and Province scale. So. And that's well beyond biodiversity.I think, I mean the biggest thing to me here, one of the biggest things, anyway, is storm water. And I think that has, of course, implications on biodiversity. We manage our stormwater very differently, you know, in the 2 parts of the area.

[Interviewer] 12:19:59

So that's a great segue because one of our next questions is what stressors are currently impacting biodiversity in your system. And what stresses are, you know, is management currently working to mitigate. So you were just talking about stormwater. I know you've talked about urbanization and climate change being the other 2 big ones. Are there other key stressors or more specific stressors, I guess, within those components, that are important for you or your work?

[BD012] 12:20:24

Yeah, I mean, certainly. I think Stormwater is a big one, and like I just said to a colleague the other day, we have to find a way to make water quality sexy. Like it's so boring. No one wants to do it right, but yet it's the thing that every urban coastal area system faces. If someone could do something to, like, help, alleviate this like conglomeration of chemicals coming out of the fresh water into the marine water, like, there would really be a lot of advancement there. So storm order is a big one, I think, but also, I think just ecosystem change, whether it's climate driven.

So here we had big fisheries in the early part of the 1900s that depleted a lot of our stocks, and they have not rebounded. And there have been fundamental changes in the Salish Sea in terms of like - we used to have species that now we rarely find, like Pollock and Cod. And some of that's climate driven. So once they kinda got driven down, they didn't have a chance to rebound, and then, as as the waters warm, they've kind of just stayed more northern. So the, like the, you know, confluence of those 2 things is so… fisheries and climate change, you know. I think, in thinking about your other case studies, like, eutrophication and hypoxia are going to be really big, but we don't actually have. We have some very acute problems with that here. But it's not - we have an immense amount of circulation relative to those other systems. And we have this cold ocean water that's coming into our system. It's a fjord. So it's like, really deep, like, just the oceanography is very different in the system than those other 2 that you're using as your case studies. So that's something - I would say, like, just be aware of that. We don't have eutrophication. Like everyone who's ever worked in estuaries are like ‘let's talk about eutrophication’, and it's not… we see it very acutely here, like there are certain inlets where you start to see some of that, but it's not like by and large. The Canadians are like, ‘I don't know what you're talking about. There's no unification.’ So it tends to happen in the South Sound, is where we see it.

[Interviewer] 12:22:17

Okay.

[BD012] 12:22:17

But you know one of the things that I've given presentations on for the Salish Sea Report up in the northern part of the country for it, there's like third… this is like third growth forests, right? So like fundamentally, even when it looks like their trees and things haven't changed, the biochemistry of those watersheds have fundamentally changed, and the way they retain water, like even looking at water flow off of those systems. So even where we have like, no skyscrapers and ports, and various other things, we still have a high level of human impact, and, like modified watersheds. So that's kind of a - I think that's one too. I mean, if anything, we've probably seen more contributions of elements to the marine system from that, you know, just because of increased runoff and stuff and erosion.

[Interviewer] 12:23:08

Yeah, okay.

[BD012] 12:23:09

But I haven't looked at specifically.

[Interviewer] 12:23:11

Yeah, that's - it's a great point. And that's, I think, the point of doing 3 case studies. And we tried to pick ones that are pretty different. So we can, you know, at this phase, be talking with experts like you to get a big-picture view of what biodiversity looks like in management. But then also look at specific themes within each case, study to dive a little deeper into some local context, dependent issues.

[BD012] 12:23:32

Yeah.

[Interviewer] 12:23:35

Okay. And so then, I think we haven't talked too much about ecosystem services. I know we're talking about harmful organisms, you said that that could be an important consideration for biodiversity. If you're thinking about the impact that might have on ecosystem service, and to stakeholders in the community. So what - what ecosystem services does your work focus on, or what services are key in the Salish Sea that we should be thinking about?

[BD012] 12:24:00

Yeah, I mean, I think mostly my work focuses on habitat provisioning. Right? So through restoration, or from conservation and things like that. Habitat provisioning is probably the biggest one, and you know, I think with that is sort of this trophic - I'm interested in trophic relationships. And so, how those habitats translate to food, for you know, herring, which is food for salmon, which is food for whales, and, you know, kind of up, up the list. So I would say that that's probably where my work focuses, related to biodiversity and those ecosystem services, like, certainly maintaining… like I think I might cringe when I say this, but I think one of the things that I think has been overemphasized with biodiversity is the number of species, right? So we're always talking about how many numbers of species we have. And I think it's such a simple metric that I feel like we need to move beyond that, and sort of understand the role of species and those ones that we don't pay any attention to that aren't of conservation value or whatever. Like what are they doing, it doesn't - yes, they're there. But what are they doing? So I think whatI think about or what I’m saying from a policy standpoint, it's not just the - it can't just be the number of species. They're like how species rich is this environment versus that environment, right? Because I think that's very reductionist in a way that's, like… some areas just don't have as many species anyway. That's like, some areas just don't have as many species. So we can't compare apples to apples and so, yeah. I think, like, thinking about how that ecosystem functions and what makes for a functional ecosystem is kind of critically important in terms of ecosystem services. So here we've got wave attenuation and sea level rise, like, resilience. So thinking about a lot of our - we have really strong tribes and natural resources agencies here. So tribes are a big part of management in Washington State, and first nations in Canada, as well. And so, in thinking about ecosystem services, they want to still be able to harvest their shellfish and various other things that are integral to their communities, and those are the ones that are most threatened by sea level rise. So thinking about resilience, through resilience to climate change, through protection of lands and that kind of thing, like, promotes biodiversity. But it's really like a habitat provisioning type of…

[Interviewer] 12:26:31

So that's our next question: who are the key stakeholders and actors in your system? So, you know, you were just talking about tribes and first nations.

[BD012] 12:26:38

Yeah, you gotta get the tribes in there. I mean, and I think that's something that maybe sets us a little bit apart in the US. That we, the tribes are like our co-managers of all of our fisheries in Washington State, like they are at the table deciding who gets what quota, and then within the tribes they divvy it up, you know. So that's really interesting. They very much a co-manage our fisheries anyway. So that's fish and shellfish. And then, in terms of restoration, I would also say the tribes are leading the charge here. They have access to federal monies that are flowing at the moment, and they're doing a lot of really good restoration. So in this region, I think that is unique, like, you're not - I grew up in Maine, and I spent some time in Chesapeake Bay, and I know a little bit about the Gulf. But I'm not seeing that level of involvement that we have here with tribal governments and big natural resources departments that are mixed between tribal folks and white guys. But you know it's sort of - they're still there, like doing the work on behalf of the tribe.

[Interviewer] 12:27:45

That's very cool. Yeah. And that's, I think again, like, it’ll be really interesting seeing commonalities and differences across our 3 case studies that we're excited to dive into.

[BD012] 12:27:53

Yeah, and maybe you can strike the white guys and just say non-tribal people. But that's like, sort of the colloquialism.

[Interviewer] 12:28:02

I - I have done not for this project but for other projects like, I've had white guys in my quotes in my model. So it happens, it’s all okay. Great. So that's kind of the end of part one. So this is a two-part interview. So for the -

[BD012] 12:28:20

Can I? Can I go back to the stakeholders for a second? I think, like our State agencies are actually really strong, and the other one that you should know about is a group called the Town Partnership, which is really a State government - like a lot of funding flows through them. And so make sure that they're… yeah. That's another one. And then, like the Department of Natural Resources, Ecology, Fish, and Wildlife. Like we do have very strong natural resources departments here spread across, you know, depending upon the issue. But we do have, I think, fairly good infrastructure, and in Canada Environment and Climate Change, Canada, etc. They're a big one. DFO, of course. First nations. And I think you know, obviously, like academics are the other folks that are involved in the science realm. A lot of active citizen groups are working in one way or the other. They tend to be more regionally focused. But throughout the state, I think you see large amounts of interest in the environment, in ways that I have not noticed living in other parts of the country.

[Interviewer] 12:29:25

Right, perfect anything else before we…

[BD012] 12:29:28

Nope, that's all we can move on to part 2.

[Interviewer] 12:29:31

Great. Thank you. That's great. So how are you familiar with the software?Or the technique called mental modeler at all?Okay, so that's what we're doing for this project. So for the second half of the interview, what we're hoping to do is take the responses, your responses, from these questions that we've been going through and putting them into a mental model and seeing how they're all connected to one another. So while you and I have been talking, [Interviewer 2]’s been building out a concept list from your answers and populating it. She'll share her screen right now and then we can just chat about how each of these different system components are connected to one another, and how that relates to biodiversity.

[BD012] 12:30:13

Okay, well, that's kind of fun. I like this.

[Interviewer] 12:30:17

Great. I love hearing that response. Sometimes people are overwhelmed.

[BD012] 12:30:21

No, I mean, years ago I worked for someone who insisted upon building a conceptual model for everything.And it's like, I'm so sold on it now, like, I make my students do it in class, like, yeah.

[Interviewer] 12:30:36

I think the love of conceptual - there's a love hate relationship that people have with conceptual modeling.So I feel like you can go either way.

[BD012] 12:30:43

Yeah.

[Interviewer] 12:30:45

Okay, so do you wanna walk through it [Interviewer 2]? Kind of your color scheme and what you produced. And then, [BD012], if there are things that you don't, you know, maybe we didn't represent correctly, or you remember…

[BD012] 12:30:58

Okay.

[Interviewer 2] 12:30:58

Okay. So I'll just go run the circle first. In white are the things that you think of when we mentioned biodiversity. The orange are those key concepts that we brought up. I pulled out harmful organisms because that didn't fit. And then I added supporting species. In green over here is our stakeholders. For white guys I put community members, as like, a nice term. If that works for you. In blue are ecosystem services.

[BD012] 12:31:30

Yup!

[Interviewer 2] 12:31:35

The pink are stressors. I put anthropogenic impacts on the environment and then put runoff in parentheses. If you think that we need to split that more I can do that. And then yellow on the left are different management actions that may or may not incorporate biodiversity.

[BD012] 12:32:01

Yeah, I think the anthropogenic impacts actually are capital in stormwater, urbanization and climate change. So one thing that I would say is like… I feel like storm water is nested in urbanization. Like urbanization is the big umbrella, and storm water is under there. And in addition to habitat loss is like - maybe change that anthropogenic impacts to explicitly habitat loss, because I think that's one that I identified in terms of maintaining biodiversity. Like that's kind of critical. And so that one would also be nested under urbanization and climate change potentially.

[Interviewer] 12:32:34

Okay, so should we remove organization, or do you think it's important to keep it separate? We could.

[BD012] 12:32:40

I just feel like it's an umbrella, and it depends if you're a lumper, or a splitter right? So urbanization encompasses, like all of the building of roads that are contributing to stormwater right? So it's like more of an umbrella term where you can split out all those different mechanisms. If you're targeting policy, you want to split out all the different mechanisms, right? Because you want to make a policy that says we're going to turn off these lights at 11 pm because it's impacting fish, or whatever. You know, like, you can make certain policies that are going to be more targeted than urbanization. But if you're talking about… I mean, that's kind of like the term we came up with. We had started - actually, just a side note. In this state of the Salish Sea report we had started calling, we had called it population growth. And then we thought that sounded a little, not really what we wanted. We didn't really wanna be advocating for like… that had a whole socio side that we didn't really want to get into.

[BD012] 12:33:39

And so we changed it to urbanization, which I think is a much better term.

[Interviewer] 12:33:43

Yeah, yeah, that makes a lot of sense. Okay, great. So then, yeah, we can leave it. I think you're absolutely right. When we go through the relationships, as I'm sure you know from using this tool before, oftentimes we do need to put them out to, you know, assess the nuances in these specific relationships between components that you can't do if you leave them.

[BD012] 12:34:02

One other thing that I wanna add on the blue, the ecosystem services, is some sort of thing that is like a… gosh. How would I describe it? So the fact that we have this cold ocean water coming in really mitigates some of our summer heat, and so I'm not sure the best term…how would I say that, like, it's kind of our oceanography right? So as, like, an ecosystem service. It's like this idea that cold ocean water that we're getting from the Pacific is really ameliorating some of our heatwave problems that we have, and like, in the last heat wave. Yeah, reduction. Or like, I’m not sure it's reduction because it's kind of not really reducing, but it's just like maybe mitigating. Mitigation for heat waves, or something like that. Mitigating heat events. Yeah, I saw a plot that the media all just put together and essentially, if you lived… like the closer you to Puget Sound, the cooler your temperatures were, which makes sense. But like, when it's a 100 degrees here, it's very rare, right? So if you're 90 versus a 100, that's like a huge difference in this region. I know that for those of you in other warmer places that doesn't seem like a big deal, but it's like a really, like, the difference between 75 and 80 and 85. People are melting at 85. They're not used to it right and so this idea it, like, has this sort of climate. It's not - It's like the opposite of a heat island. It's like a cool island and like, you know, have you heard of like our heat islands and urban centers? Because it's like they're all kind of whatever the opposite of that. I’m not doing a very good job articulating this

[Interviewer] 12:35:50

Yeah.

[BD012] 12:35:53

at all.

[Interviewer] 12:35:54

No, I know what you mean. I actually, I did a field program at UDEP Friday Harbor labs, and I did a lot of sampling. So I know very intimately what you're saying.

[BD012] 12:36:00

Okay. Yeah, it's cold.

[Interviewer] 12:36:11

So we - you added, ok.

[BD012] 12:36:15

And the management and actions, I think, like MMPA.

[Interviewer 2] 12:36:21

That's species -

[BD012] 12:36:21

It’s kind of nested in the species of conservation concern. There's the Major Species Act, which I didn't even mention, but that's another one. So maybe under a species of concern management, you could just put MMPA and MSA in parentheses there, because MSA governs so much of ourselves. I think that looks pretty good.

[Interviewer] 12:36:49

Okay? Great. Yeah, we can change, add, remove as we go.

[BD012] 12:36:53

Yeah. And I think the only other one that I'm sort of questioning is that fishing industry?I mean at this point, our fishing industry doesn't have that much. We don't have a lot of commercial fishing. So that one may be more important from that angle. Yeah, so…

[Interviewer] 12:37:17

Okay, great. Okay. Anything else? Before we move on to relationships.

[BD012] 12:37:23

Nope, and I haven't used this software before, like, I'm vaguely familiar with. I mean, I kind of understand mental models. But I haven't used the software. I may not know where we're going next.

[Interviewer] 12:37:31

Okay, yeah, I, okay, yeah. I'll give a quick overview. So what - what we'll do is [Interviewer 2] will draw the relationships as we talk, so we can lump them by bin, just to make a it little more streamlined. So I'll start with the orange boxes, if that's ok. And we'll go through each bin, and I'll ask you… what if there was an increase in supporting species, for example. Let's start there. So if we were to increase supporting species, how would that impact the system?So would any other specific component in our system be impacted by an increase in supporting species, and then for each relationship that you see, we'll talk about whether or not it's a positive or negative relationship. 2 components can have a bi-directional relationship.So the arrow can go both ways, and then, if we can, if we get to it, then the third final piece is that we can assign a relative weight to each relationship of a low, medium, or high impact. But usually what I do is I draw - we draw a few relationships to get started, and then we can talk about the weights as we go.

[BD012] 12:38:39

Okay, can we start with habitat forming species? Just because I feel like that one is a little bit more straightforward and it might be an easier place to start. Okay. So I think there we have, like, ecosystem stability.

[Interviewer] 12:38:48

Absolutely.

[BD012] 12:38:53

And the 2 gray boxes. I feel like there's direct relationships there. I think they're also for consumption. I feel like that's an important one, because so many of our species use those shallow water areas. And then also for sea level rise, resilience, and wave attenuation, and then habitat provisioning. And, okay. So, what I didn't mention was ocean acidification.

[Interviewer 2] 12:39:21

Yes.

[BD012] 12:39:24

But now I'm seeing, like, those habitats for me, we're talking a lot about them as buffers for OA as well. So that's a stressor, yeah. And then, if we increased habitat forming species, we would have less habitat, or like, it would counter habitat loss but I'm not sure that'd be negative. Okay. And it would probably be positive for species distribution changes, because more habitat might, it could go too ways that I see. Hmm!

[Interviewer] 12:40:05

So it could be - go by directional, or you're saying it could be positive or negative.

[BD012] 12:40:09

I think so. One of the things we've talked about with… yeah, I think it could go both ways. Because one of the things we talked about with salmon and restoration as more habitat becomes available, is you might see a decline in abundance at an existing spot, so it is kind of both ways. Even though overall it's a net positive, right? But you may see decreased densities because things are now spread out as more habitat becomes available, if that make sense.

[Interviewer] 12:40:37

Yeah, yeah, exactly. So, okay, so, I see, we're not. I don't think we're talking about that arrow right there, [Interviewer 2]. I think we're talking about that it could go either way. Increase and have depth.

[BD012] 12:40:48

Just leave it positive. I think positive is fine for distribution change. But we're talking about abundance. It could be… yeah, it could be. But that's local abundance, not overall. So that's net positive. And then I think it's obviously relational with the habitat forming species management. So, this is like our Shoreline Protection Act and stuff like that. Yeah, okay, yeah. So does - with the arrow it could go, I think it would go that way, based on what you're saying. Yeah, okay, okay, great.

[Interviewer] 12:41:21

So to go back quickly to the habitat forming species, to the species distribution. I think that's a good spot to start talking about weights a little bit, because you were saying it's not positive, but I think maybe it would be based on how you're describing it. It wouldn't necessarily be a high positive, because it could be negative. But it's net positive.

[BD012] 12:41:39

Although with distribution, I feel like it's different. That's, so, that's like the arrangement of species in space, right? It would be… I feel like it would be strongly positive.

[Interviewer] 12:41:48

Okay.

[BD012] 12:41:49

Where, if you're talking about abundances, that's where it may be. So, if, instead of species distribution, we had species abundance change, then you may start to see a decline in places as a relative decline in density, as more habitat becomes available.

[Interviewer 2] 12:41:54

Okay.

[BD012] 12:42:02

But it still could be a net positive. So I'm reversing my thinking on that.

[Interviewer] 12:42:06

Okay. Hmm, okay. Great. Okay. Well, while we're talking about, maybe, I'll ask… so, thinking about these relationships that we've drawn right now. We put them, as you know, all positive, sorry, all high for now as a weight of one. But when thinking about these relationships relative to one another, are all these relationships strong, or are there some relationships that maybe have a lower medium impact on the other?

[BD012] 12:42:35

Yeah, probably. Like the wave attenuation would be lower, and like sea level rise resilience, would be relatively lower than like, habitat provisioning, which is essentially the strongest cause. That's what it's doing.

[Interviewer] 12:42:51

Okay, yes. You think a low impact or medium impacts for those.

[BD012] 12:42:57

For sea level rise, probably low. SLR resilience, that's a low. Like a 3 out of 10. I don't know what your scale is.

[Interviewer] 12:43:02

Okay. Yup, that's for - yeah, we usually do like point 3. It's technically… this software has 0 to 1.

[BD012] 12:43:11

Okay. Yeah, and then for habitat provisioning, it would be like a one. Right? Because that's - if you have habitat forming species.

[Interviewer] 12:43:20

Perfect. Okay, great anything else? Before we move to a new box.

[BD012] 12:43:28

Probably the habitat loss would be pretty strong. A strong negative, like, if you didn't… I kind of feel like that arrow should be the other way. So habitat loss would be negative for habitat forming species, if that makes sense.

[Interviewer] 12:43:44

Yeah.

[BD012] 12:43:48

Yeah. Strongly negative. Yeah.

[Interviewer 2] 12:43:57

So as we go on, whenever I draw these relationships, I just default to like positive one or negative one.

[BD012] 12:44:06

Okay.

[Interviewer 2] 12:44:07

If, as we're going through it, you think like this is medium or low, you can just let me know that, and then I'll -

[BD012] 12:44:10

Okay. Okay. Sure. Okay. And then, yeah, I think that looks pretty good for a first cut. I mean, if I sat with this for two hours, I'd make changes. But…

[Interviewer] 12:44:30

Okay, perfect. So maybe we can move to a species of conservation concerns next.

[BD012] 12:44:34

Yeah, I like that. So then we would have the most, the strongest arrow I can think of is the conservation concern management to conservation concern, that's strongly positive. Right? And then species of conservation concern would be… so like species, distribution changes down in the pink up to species of conservation concern would be negative, strongly negative, and then climate change would be maybe weekly negative, or like moderately negative, moderately.

[Interviewer 2] 12:45:01

Ok.

[BD012] 12:45:12

And then urbanization would be point 3 I'd say. Maybe point 4. Actually, I'm changing my mind. Sorry, [Interviewer 2].

[Interviewer 2] 12:45:27

No!

[BD012] 12:45:35

And then habitat loss would be, also, like, a point four because some of those species, I'm thinking, like, they have huge ranges. So habitat loss, like, is neither here or there, maybe, but for salmon and for crabs and things, it would be. Okay, so I get those. So now, the conservation concerns. So I think tribal groups and first nations need to be linked up there somehow. So specifically, conservation concerns are positive to tribes like that. It’s pretty strong. Yup and community members, like people, really love their Orcas. And, I mean, state agencies are neutral. Like there's a link there because they're the regulatory bodies. But I, you know, they're kind of like just doing their job. I don't really know where the academics fit in.

[Interviewer] 12:46:38

That's fine!

[BD012] 12:46:38

Okay, let's see, species of concern... okay, conservation concern.So I think for consumption. That's like a big, strong one there.Because yeah. You know, these are generalizations. So there are like, lots of species that people don't eat.

[BD012] 12:46:55

So in terms of that, salmon is king with Orcas as a strong second, but no one eats them.

[Interviewer] 12:46:57

Yeah.

[BD012] 12:47:02

Let's see… and then habitat provisioning would be, like, a positive. Like, that ecosystem service would be positive for species of conservation concern. Oh, my God, this is gonna be a major spaghettiogram by the end, isn't it?

[Interviewer] 12:47:22

They usually are. Yes.

[BD012] 12:47:25

And then we already have habitat loss. Okay, storm water, maybe. Like, I'm thinking of shellfish which might be like, yeah, weakly negative. And - or like, 0.4. And then they’re also with habitat forming species, because oysters are really important. Our local native oyster has been almost entirely eradicated, and so that's a habitat species for me. And then, let's see. So we did… I think you need to tie a link in there from transboundary to this conservation concern, because many of these are migratory, and they don't actually turn around at the border. They just keep swimming. So we gotta put that in there somehow. And then maybe also ecosystem stability in this. Like, it might extend up through the watersheds even. Because… which we don't really have well captured here, but things like salmon bring marine nutrients to the forest, so. Yeah. And that one actually could be drawn to - the supporting ecosystem stability could be drawn to the key food web while we're on that one. And the supporting speaker. I'm jumping around now, I'll try not to.

[Interviewer] 12:48:55

No, that's like… sometimes it's more streamlined to jump around as you're thinking about it. Whatever comes to your brain works for the process.

[BD012] 12:49:08

Okay. So now, if we go to key food web supporting services supporting species, I think this is tribes and first nations that are weakly tied in, because, like right now, it's species of concern that might be the most tied.

[Interviewer 2] 12:49:10

Yeah.And that's - sorry. That’s the key food web supporting species impacting academics?

[BD012] 12:49:38

So I think it would be the other way. That people are studying, I'm thinking of like… so maybe not academics, but just like science, like progressing science of understanding, or something like that.Academics might be the right… let's not draw a connection there at all. Actually.

[Interviewer] 12:49:50

I see. Okay.

[BD012] 12:49:57

I feel like the, like, those stakeholders are kind of… there are connections between those and all of the yellow box, you know, cause like the policy, like sort of best available science. Yeah, those - all of those agencies kind of have connections to policy.

[Interviewer] 12:50:18

And would you say those are all high, strong connections?

[BD012] 12:50:21

Yeah, they're probably medium, because they're not - like if they generalize, you know, there's like, some are important, and some are not as much.

[Interviewer] 12:50:28

Right. Okay.

[BD012] 12:50:33

Except tribal groups. First nations, I mean, they definitely see, you know, this would be, like, a strong ecosystem to align science and management. That's like something that's important. But they also are very interested in their own geographic location, as well.

[Interviewer] 12:50:49

Right. Okay, really quick. I think, [Interviewer 2], did you take out, I think, the key food web sporting species to tribal groups? That was a low positive, right, that we wanted to keep or take?

[BD012] 12:51:02

Low pause to keep to tribal groups. And then consumption. I think the key, yeah, this key food web to there would be, like, do we get that one to consumption? That would be, like, kind of a low, like a low point. And then they would be negatively impacted by habitat loss. So habitat loss to key food webs, and storm are the same. Maybe like a 0.7 or something for that one. And then OA would also be negative to - yeah. But also like 0.5, maybe because it's not, like, there's a lot of differential response to OA in this region. An urbanization would probably be negative, at like a 0.6. Species distribution changes would be negative again, like 0.7. Maybe like, it's not - there's gonna be some win and some lose, with climate change. I think there’s probably more losers than winners by and large. So 0.7. Okay. Hmm. Alright. That’s okay, for now.

[Interviewer] 12:52:51

Okay.

[BD012] 12:52:54

So now supporting species would be the other one that we need to tie in. So I feel like that one has a lot of the same negatives from the stressors.

[Interviewer 2] 12:53:16

If they're all the same relationship values for the stressors, then I can just put them in after.

[BD012] 12:53:25

Okay, yeah, I think it's probably… yeah. Yeah, I think that's fine.

[Interviewer 2] 12:53:25

So we save time. If that's okay with you, if they're different, then we can go. Okay.

[BD012] 12:53:34

Okay. So then, for the other groups, like the supporting species, it's weird. I'm kind of struggling with how to incorporate the 2, like the 2 boxes with biodiversity.

[Interviewer 2] 12:53:46

Okay.

[BD012] 12:53:53

The definition of biodiversity. So I feel like it's also kind of like urbanization and it sort of, like, umbrellas, supporting the assemblage of taxonomy, and a place number in population that went to supporting species. I think that would have to be positive. Instability. We already did that. Okay. So this - did we get species of conservation management? I think that has to get drawn to key food web supporting species. So that'd be positive on key food web supporting species. But it's indirect. So it would… can I? In what way is it? Indirect?

[Interviewer] 12:54:53

Could you talk, talk us through that?

[BD012] 12:54:54

Well, yeah, because those key food web supporting species, like, I’m thinking of salmon management, where a lot of work on herring, because we know that salmon and eat herring, and so that herring would be identified. They're not protected under some federal policy, or even state, and so they are key food web supporting species. But they're not like - the management is not… it's only adjacent, right?

[Interviewer] 12:55:20

Gotcha yeah, no, that…

[BD012] 12:55:21

Does that make sense?

[Interviewer] 12:55:25

So, if there are… I'm just trying to think, because usually, like, if we have that low relationship, that would represent in the model a low direct relationship. So if it's only indirect, and it feeds through another, we probably want to get rid of that specific arrow. But then I would wanna make sure that we had the feedback loop though.

[BD012] 12:55:47

I think it’s a direct relationship, just because some of the stuff, like a lot of the research, is focused on, you know, how are these ESA protected species relying on other species. Then, yeah, we just - the ESA doesn't extend that far.

[Interviewer] 12:56:14

Okay. Great.

[BD012] 12:56:14

It's taxon specific. Okay, where are we at?

[Interviewer] 12:56:23

So we're there… any others that we needed to come from supporting species where we were.

[BD012] 12:56:30

Oh, yeah. Yeah. Supporting species. So species distribution changes would be positive. It could be both. That's bidirectional, right. Because you could have distribution changes in supporting species, positive on supporting species or negative. And those things may not be, like, truly positive or negative, depending on that context, and it’s likely to fluctuate.

[Interviewer] 12:56:56

Okay.

[BD012] 12:56:56

So I think that should be bidirectional at like 50%. 0.5.

[Interviewer] 12:57:00

Okay, in both directions.

[BD012] 12:57:02

Yeah, in both directions. And then climate change would be negative on supporting… Oh, we got that, looks like. Urbanization might be negative on supporting species, too. I’m thinking of shore crabs and arthropods and things. And then habitat loss, that one would also be negative on supporting species. Okay.

[Interviewer] 12:57:48

Is that good for the orange boxes?

[BD012] 12:57:51

I think so. I'm trying to figure out how to tie in mitigating heat events, because that would be like…it's not - it's like, we don't really have any, like, physical things in here. Because it's, like, biodiversity focused right? But yet we need some kind of, like, ecosystem thing to tie that in. But I'm not really sure how to do that. Maybe ecosystem stability would be negative to mitigating heat events of the oceanography. That's what that one was intended for.

[Interviewer] 12:58:25

Okay.

[BD012] 12:58:27

As ecosystem stability declines… that I don't know. That doesn't seem to really work, either, might be the other direction.

[Interviewer 2] 12:58:35

Okay. Okay, so increasing the mitigation of heat events has a positive effect on ecosystem stability. That's what you're saying.

[BD012] 12:58:44

Yeah, if the ecosystem is like…yes. Do you see what I'm saying? That - there seems to be this like, physical chemical thing that's absent from the biodiversity realm that would have, like, some of these other ecosystem services kind of driven by that.

[Interviewer] 12:59:00

Yeah. Then we talked about having some sort of like autographic, or even, like, broader ecosystem processes components of this, but, as you can see, the models are just getting a little out of hand complexity wise. We were trying to narrow in on what we were -

[BD012] 12:59:27

Yeah, I do think, though, as you consider your case studies, I mean, that is going to be such a fundamental, like, foundation for how things respond. Like, how biodiversity responds to stressors, right?

[Interviewer 2] 12:59:46

Okay.

[BD012] 12:59:49

So one of the big things I emphasized in the State of Salish Sea report and the paper, and when I give presentations…we have a lot of water. and because of that, and then because of the way it's moving, we really are doing a good job, like, diluting a lot of our problems. For years the city of Victoria has been dumping untreated sewage into the street and it was never a problem, because our oceanography is, like, sweeping it all out to sea. And then it's taking it away from the population center’s sewage treatment. But the situation hasn't really changed. So like, that's just, like, one story of why that, like, physical context, is so important. Okay, where do I need to focus next?

[Interviewer 2] 13:00:34

Sorry. Real quick, [BD012], so it's one central. I have to hop to another meeting. I can send you the model, [BD012]. We can look through, if you still have time to work on this. If not, we can end here. I booked an hour and a half. I know that's so much of your time.

[BD012] 13:00:57

I, probably. Yeah, I have another half hour. I could work on it. If you guys wanna keep going, it’s alright if you wanna keep going.

[Interviewer] 13:01:03

Yeah, that'd be great. Sure. Yeah, let's do it.