[I1: So like I said, a little in the e-mail, said a little. So the really high level research goal of this project is to understand if and how we're managing for biodiversity, directly or indirectly, in U.S. Marine resource management. And to understand what approaches are needed in the future to balance access with conservation. So to do that. For community members.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Access to be able to participate.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah, and access to biodiversity.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Access to biodiversity.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah, marine and. So all marine and coastal, which is, yeah. So obviously you know with your research exam, it's been a little challenging here because of the terrestrial and stream aquatic dynamics with salmon. Yeah, we'd love to talk with you about, you know, the whole system perspective. From, you know your perspective in your research, we are like trying to narrow in on just coastal and marine, but it's hard to tease apart the salmon of course. But so yeah, so the answer to that research question, we have 3 case studies. Puget Sound is our third. We did one in the northern Gulf of Mexico really end up being more like Mobile Bay, Alabama, where Sarah and Steven are, then the second was Chesapeake Bay, where Smithsonian is where we are. The third is Puget Sound. OK, Phil Levin at he was one of our team members initially. So that's how we ended up with this case Study. he had to leave our team when he went to the White House. Yeah. So that's part of the reason why Sarah here for like 2 weeks to meet with folks kind of do some scoping and. Some more, right? Perspective. So in each of the case studies, we're having individual meetings. And interviews with community members. We're talking with a variety of marine resource users, fishermen across different sectors. Oyster farmers, waterfront homeowners, ecotourism operators and then we've talked with a few tribal managers. Managers and then researchers like yourself, other like state and federal managers and researchers. And academics and NGO practitioners and researchers. And then we're convening community members in a workshop in each of the three case studies. To Have more of a collaborative discussion around. How community members value and rely on biodiversity in the system and try to understand if those the aspects of biodiversity that they rely on aligned with the aspects of adversity that managers are thinking about. When they're making their. Decisions. So to start with, in that context, we would love just to learn a little bit more about your research in your area of expertise.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: So I. My area of expertise is salmon and steelhead, which are a some on it but you know same but those are like the main those are we have all five in steelhead here in Washington state. And. That's. I mean, it's amazing how you can really specialize in that here.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: And so I was looking at some of your research, you know, perhaps for this meeting.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Oh. Yes, I didn't talk about. Research, yeah.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Oh, no, no, yeah. I was just. I saw some of your work on, you know, working on declines in salmon body size, which is something we keep hearing about.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: So I worked on. That was more in Alaska when, because that was my graduate work, so life, life, history changes and. Feel felt like it was. It was kind of hard to. We actually did some fisheries selection. I did some of that earlier actually. While I was a post doc here. In the Columbia River. But it's been really. To. That data and those kind of analysis up here. Almost like we've like we've. There's just there's not enough anyways. Not. Not enough data or they've kind. There's too much hatchery influence to really be able to look at those questions the same way in Puget Sound. So so my research has shifted since I have been working with the state. To questions of just general marine survival general marine survival. You know how many are getting back and what are the environmental variables related to that? We've I've done a lot of work on. Life cycle modeling. To. Kind of. What are the? Obviously including the marine environment and then. More freshwater stuff having to do with, you know, having cap restoration. And also more recently trying to even how trying to better estimate the adult abundance. I'm sorry. How many even get? You know how to estimate that better and then also some kind of tools to improve management. Called integrated population models and management strategy evaluations, applying those to salmon.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah, I'd love to hear more about specifically that last point about the tools to improve management and some of the management, the management strategy evaluation work that you're doing.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah, you know. I mean, it's kind of funny because I feel like in Alaska because it's a more natural system, you know, you can ask, you can kind of do these more. There's a little like you don't need to know how many fish are exactly spawning. As long. As you're kind of in the ballpark, you're gonna. To be fine 'cause there's the. There's much less of a buffer down here. And so you really need to like so, so so we need to like getting just even the basics. Is you kind of have to go. To. Basics a little more like because if you you have to, we really have to better know how many fish we have because we're at the point where we have so few fish that if we're off by, if we. Know like we're the point where, like, we're there, they're shutting down so many fisheries. And so it's. Adult abundance estimation is, is is even more important because we're kind of at that edge of of shutting things down and. We've also, you know, because. Washington is older than. They've also been doing things a certain way for so long, and like now, like, why are we still doing things Like for the 1970s? Baselines have changed and things like. So that's why that's so I feel like that's kind of the basis of fisheries management in Washington. Try to even figure out how many. Adult fish we have and then. So because we have a lot of Endangered Species Act listed stocks, if you want to, if you want to conduct fisheries. Noah has to give you a permit to do so. And we, because even though you're off and going after, you're going to harvest, you're going to target hatchery fish, you're still going to affect natural origin fish, which are the ones that are being the focus of recovery. And so you have to have a permit. And so the challenges that like down in the Columbia River. We don't have permits from Noah or they we kind of had provisional permits or they're expiring. And so it was by doing Msas we can better use use the information on. Umm, how how different harvest control rules like, you know, harvesting 10% or all have an escapement of, you know 1000 fish and then you can harvest after that or different? Different carrots as the official term. Which of those will allow us to more consistently harvest and more consistently meet the goals of recover of of escapement goals, flash recovery? Is in terms of I guess this kind of ties into biodiversity and you know whole portfolio effect and. You know, like, like fishermen want to fish more consistently. And so having. Like with biodiversity, you know it basically gives buffers and so by by having some sort of harvest control rules that allows. For more consistency over time, you're kind of buffering. People against that variability, which is really hard as a as a fisherman.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: So yeah, so all I can jump into some are more specific questions around biodiversity. So one of the things that we learned early on in this project is that the term biodiversity itself means different things to different people. There's a lot different definitions, a way to conceptualize it and measure and operationalize it. To start. Big question, but we're wondering what you see As the key. Aspects of biodiversity and what you think about when you hear that term.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah, it's a tricky. I was actually gonna ask you to define. I mean, I guess in some ways like because my research is very salmon centric, I sometimes struggle a little bit with. But obviously I know we know that salmon don't live in a vacuum. And so it's, you know, there's there's so much that salmon kind of represent and and and are related to and kind of. Are part of. And so. But I think a lot of times people who study salmon and think about biodiversity, I think we think about, as I said. Variability and buffering and portfolio effect. Because. If we can have. Diversity in the salmon stocks. You can have this buffer in. You can have a greater portfolio effect and therefore you can have more resilience of the populations over time purely on a biodiversity. I guess you would think about like, I think Davina, I guess this ecological background would. All the different species and you know and and. Like like people, users wanting to target lots of different species and not just like I only target salmon.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah, yeah. Got a lot of really interesting different responses, so it's been. We didn't have that question initially and we kind of had to adapt because of, you know, some of the responses we're getting people asking us for definitions. Been interesting. OK. So one thing that we did early on when we started realise that people think about biodiversity in different ways is build. A framework with, or bins to help conceptualize biodiversity of different types of species, and we're wondering. We're hoping to get some feedback from you and see if this makes sense and if you think. These components in your research. Umm, so the first is habitat forming species. Then we have key food web supporting species, yeah.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Is that forming? Yeah, like has, like, species that like salmon. That's like affecting their ecosystem.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah, yeah, so does that. Does that framework and does that specific term to start resonating with you makes sense to you? And do you think about that and think about that bin biodiversity in your research, in your work?](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: So I think, I mean, I think that we know that salmon are like a keystone species and actually like change stream bed. Structure and function. Yeah, so they do. They are habitat forming species in terms of biodiversity. I could only. Yeah. I mean, it seems like salmon are like are instrumental because they're keystone species, are instrumental in in shaping the biodiversity of freshwater ecosystems. And I mean, there's been lots of work. Showing that you know salmon nutrients are super important for, you know, stream ecology and you know we we've been really this this horrible cycle of, you know, like a few salmon and therefore you have fewer nutrients that they bring back. They bring fresh fresh water. Supposed to be focusing on marine but but. We were salmon. This is, I think what we think about we don't think about them affecting their Marine. Environment. Think about them. Actually, the freshwater environment, OK. I. They use they obviously. And actually I take that back. So because there's been a bunch of recent work on pink salmon, I don't really know. Like I I feel like I'm, like, stuck in this little salmon hole, which is great in a lot of ways, but I hope. That you will be like, Oh my gosh, she. About. I don't, but I do at the same time. But anyways, there's I don't know if you like, know the species of salmon and if you've been reading about it. But basically there's pig salmon or one of the species, and they are. The most numerous and numerous and in number and in weight. Even though the smallest salmon, because there's numerous in the North Pacific right now and there has been a lot of research showing that they are strong. There's there's. It seems that they are strongly affecting. The community in the North Pacific, because they there are so many of them, there's huge hatchery production in Alaska and. And then there's also, obviously there's a lot of natural naturally produced they. The. They are the dominant salmon species in in Puget Sound and they actually kind of overtook the other species in the late the late the early 2000s that late 1990s, early 1900s, early 2000s. And so basically showing that like they also, there's also been some papers showing that they've affected like. Burt, like some turns because they migrate all the way from New Zealand to Alaska, and because they are eating a bunch of zooplankton that then would otherwise be eaten by other things that would otherwise be eaten by turns. Anyways, there's been really there's this is some really cool work in terms of how pink salmon are affecting the ecosystem they're affecting, you know, birds they're affecting. Other marine fishes and there are seem to be impacting other you know other species of salmon that would you know that have less food and that there there's more competition in the Ocean and actually this one paper. Is actually showing that he's hypothesizing that they're even affecting humpback whales and killer whales, so you can, like, go all the way from, like they're affected to plankton to large charismatic megafauna, you know mammals. So that is definitely something that that like, I think this Alaska fish and game is really does not want to hear about it right now because they pump out a ton of hatchery fish and it really, really strongly supports. There's a. There's Aqua called a huge pink salmon aquaculture, especially like in Prince William. I know that is. But here in Puget Sound, we are also concerned about pig salmon because we like pig salmon, but we like chunks of salmon. Lot more. And so we are concerned. We are wondering if. By the switch to somebody, pink salmon in Puget Sound, but also when they go out in Puget Sound. Because pink salmon, like I said, it's taken over as the most. Successful in part because they have a really short freshwater life and things are not great in freshwater with climate change and habitat. And so pink salmon basically come in and spawn, and then they're they're juveniles, leave immediately and head to the ocean versus the other species. Kind of in freshwater.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: OK. That's great. That's that's like exactly what we're looking for, is trying to think about, you know, these food web interactions and how some of this research translates to biodiversity, so that that that's super helpful. Thank You. Anything that ties nicely into our next question, which I. think You may have just answered is what about. Key food web Supporting. Yeah. So maybe you. Answered that, but is there anything else you want To add onto that, I mean.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah, I guess in some ways like habitat, physical. Yes, they're all interrelated.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: And then probably also answered already, but species of conservation concern.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah. I mean, I think that like again this whole like how how salmon are. I mean, I guess that's such a key here is and I didn't or Haven't talked about. We haven't talked about sea lions and harbor seals, but like an orcas, because that's all such a like muddle in Puget Sound, which I'm sure you've heard about.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: We've had some interesting meetings. We've been meeting, we've met a couple of fishermen we met with the whale watching naturalist, which is really, really cool and a dive shop owner. So we've had really cool meetings across, you know, different stakeholder groups, its been fun.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah, yeah, yeah. I mean, I think a lot of people could agree that we need fewer seals. And so I think. But but but I mean like it's really hard to undo the shift of NOAA, the Marine Mammal Protection Act.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah. Yeah. Yeah, yeah, yeah. OK. OK. And then the last one is harmful organisms.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: I mean, I think some people would. That. Salmon could be considered harmful organisms in some. Like maybe maybe that maybe they are in the mass numbers but but but it's not really. Seals are harmful organisms, and the mass numbers that they are.Yeah, there's also concern about, you know, there's also been hypothesis about one of the reasons why there. Fewer fewer and Fewer salmon is also because of marine predators, which I know less about, but there's definitely concerns about salmon, sharks and salmon shark. Like. And like Northern resident killer whales are eating some. Them because they do swim up. And there the northern residents. Doing really well. Of that I can like refer you to a paper that like goes through in more detail about this predation hypothesis that's limiting Chinook salmon. But I can't remember my head.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: That sounds. OK. So basically salmon fit into all four categories, which is interesting. OK, awesome. Is there any other? Anything we're missing in that? We just said salmon is all of them, but like any other bins biodiversity that you think about in your research, that maybe we haven't covered within that. That we should know about.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: I mean, I think again coming down to like biodiversity, we're really we're trying to think about portfolio effects, which isn't really like. Maybe it's. It's more just diversity. Instead of biodiversity, you know, like diversity within salmon instead of diversity among species, including salmon. So I'm not sure how you want to run there, but that is definitely something that I think a lot. Try to think about is how he gets more buffering back into salmon because we've. We've so many hatcheries, you know, they just pump out similar stocks. And so there's less diversity. Know we've like we've compressed runtime, we've compressed ages and so that's less. Diversity slash biodiversity. I don't know what your. Definition of biodiversity is.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: No. And that's that's. Been thinking about as well. Yeah. And so you're thinking when you say diversity within Sam and different species and then hatchery versus Wilds?](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Have your ears as well. But even like like return timing like there's salmon are pretty cool because there's spring run and summer run and winter run which are the time that they come back to fresh water from the ocean. And so that means that they're passing through places. To Be fished or to be prey? By, you know other. And also like we we pumped out hatchery fish and so like some like like. So like they basically used a certain stock and they put them all over and so now you know like now like all these stocks in different areas are doing the same thing. And so you don't have that diversity. We've also seen a lot of compression of we've seen a lot of losses of older fish. And bigger fish. And so that's a. That's a concern, you know, because also it means that like for salmon, pink salmon are kind of maybe some reason they're doing well is because they. We're, you know, like they, they, they they have this life history where they spawn every two years, so they can't. No age. There's no age diversity, but. Really don't home to the same home to same river. They they stray more than other species versus other species. Have more diversity of age and so they can like if it's a really bad ocean here and pure fish survive that year. But then next year is a good year. There's still some out there. So they will search for that, that cohort, that group, that part of the year will survive better. But when you are losing, when you have a compression of age composition, you're losing that ability to take advantage of. Of of temporal variation, instead of just the spatial variation that pink salmon take advantage of. Or even, I mean, this is like you even really get in the weeds about like salmon are known to some stocks. Like when they leave, they go into Puget Sound and hang out there and then they go out to the ocean versus some just go out to the. If you use the same hatchery stuff then. All do. Same thing and versus you know, I mean there's you can really. That's what I think cool about salmon. We know so much. Don't know enough, but we know so much that we know about how much variation there is naturally occur and how we are pressing.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: OK. One thing that we we haven't really heard a lot about, we started to a little bit here but less so in our. Case studies. Is genetic diversity, is that something you think about as well?](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: We definitely think about again this is having. Do. Like just what I've been talking about here, because each stock has its different. Each population is different. I mean, they're all like they have. They've done a lot of genetic work on salmon into, like, categorize them by, you know, we have the coastal stocks, which are different groups than Puget Sound stocks, but still even with Puget Sound, each population is, you know, they have definitely are able to identify different populations and. Yeah, we've really messed with it by by just like by kind of spreading hatchery fish, which we. First of all, we didn't know about it. Then some people just don't. Care.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah. Yeah. OK. OK, great. So then to move on to some of the management dynamics, are these components of adversity that we've been talking about from your perspective, are they currently considered in resource management? Or in this case fisheries management.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah. I mean it's tough because yes, they are by some people by many. But we have in Puget Sound there's a there's a major issue which I don't know if people, you probably sounds like you. To some dribble people. So I mean, the tribes have been totally screwed for many years. And when you have no fish, I think they would rather have some undiverse at this point, they seem to want want my. My observation is they seem to want some fish even if they're less diverse hatchery fish. Then diverse wild fish or. Or because you. Well, there's not too. And so it's almost like it's almost like. Like. Because right now our struggle is that hatchery fish are doing much better than natural urban fish. And so. So I feel like people are thinking about it and like we are, we are, there's, there's conservation organizations. Don't know if you've talked to anybody from. Wild fish Conservancy. Or if you've heard of that anyways, that's a group that basically spends their time going around suing the steam or the Feds to stop them. This is one of the things that I should. One of the things they do is suing the state the feds, to release fewer hatchery fish. And so and they do it in Puget Sound, they done it in Lower Columbia and like I think a lot of people, a lot of people agree that we are releasing. Many hatchery fish. But again, the tribes especially are saying if you step we used to have three fish, we're not go. We don't. We don't have any fish, period. If you release reduce release your hatchery fish, we're really not going to have it very many fish. And so it's it's just such a tug of. Such a tug.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah, yeah, that makes. OK. Are there any management approaches that you think are needed? Better manage these dynamics and better managed biodiversity.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084:](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[Yes, a lot. I mean obviously like a. I mean, seriously, they go to these meetings every. I don't have to go to because I'm in the science group, but people are in the more management group, go to these meetings with the tribes and they argue. Individual fish. Because they they have these models that track the fish back through the ocean. And because and because we were so low, they are like haggling over 1 fish and then they shut down entire rivers because because it's weak stock management. So if you have one stock that you have few of and there's a chance it is going to get caught in somebody, some other fishery that to shut down all the fisheries because. Of because you have to save that stock like the Stillaguamish river for example. It's really doing poorly and so if any fish are going to catch any fish any above, let's say they can catch like 60 fish. And if they catch more than 60 fish, they have to shut down every fishery that they've shown could possibly catch Stillaguamish fish. Yes. So even like fisheries within Puget Sound, so includes state and tribal fisheries so. Anyway so, but this one of my so so that is that is really tough and I guess think it's like it's like it. Not really. We're not really in a win situation because you have so few fish, so I don't really know in that case like. We need better management to like not have people screw up the habitat and. We need. I think we need to shut down more of the Alaskan and Canadian fisheries so that we are not so limited down here because all the fish go and just come back and get hit and then they end up here. But of course, that's my perspective coming from here. And then in terms of management in terms of like where? Have. Little bit more buffer like these management strategy evaluations I think are really good because you can do these kind of simulations to kind of show better what your different options are going to lead to. And you can produce these kind of. Figures showing like if this is your priority, these this is the outcome of these different strategies for this priority. And but it's also here's the outcome for this other. Priority and so. Like like a scientist, we can show you this and then you managers policy people. Then you get to choose, but at least you're more informed.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: So we've talked a bit about stressors of Course in the system. What other are there other stressors away from touched on that are really impacting these biodiversity concepts that we've been Talking about.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: I mean for salmon You have the four H’s you've probably heard about those. Yeah, to me, I feel like a lot of. Are like. Yep, like. Haven't got it all 'cause they're in the ocean and. Water. And so yeah. Yeah. OK.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: And then. The last kind of two-part question is what ecosystem services from your perspective are related to the biodiversity that we've been talking about, the salmon and what stakeholders are affected by some of these system dynamics we've been talking about.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah. Yeah. I mean, I think I feel like we've talked a. I mean, I feel like we've, like, we've like people who want to fish at all. Like non, like tribal people who want to tribal people who want fish, who like. We're just. We're connected and then non tribal people who want to fish. Are just are unpacked, but also like I mean. I feel like culturally, you know, around here, people. I mean, Seattle used to be Seattle has. I mean, many people I know who live here don't didn't grow up. And so it's definitely becoming less about people don't know about the history of salmon as much, but so I would say people care have under average care less now. But but when you have more people. New kind of a history of it and. The average person would say, I mean there's like they are like on the freeway, there's salmon and there's our salmon art. And so I think I think the average person does care, but I would say it's definitely been watered down more with more people moving to salmon little. Yeah. Not like born in. Yeah, I mean you, I mean, Washington has grown dramatically, yeah. I mean, it's grown I. I mean in generally and I mean we've had like a lot of like educated people come here, you know, people like tech and like, I mean, you know it's not. Like people generally who who? Can be taught to care but. They don't. They don't know if. Don't know. They don't know if they're from new england. They don't necessarily think about as if examined right.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah, exactly. Great. So those were all of my. Sarah, is there anything that you would like to run through?](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I2: There are just a few Things I want to make sure I understood this. So while you've been talking, I've made what we call like a mental model of what you've been. And how you view the system as it relates to standing biodiversity? And so I want to make sure. Some of these correct. Connections are. So to Orient you a blue arrow. Is a positive. Impact So like the marine Mammal Protection Act, positive sea lions and then orange is negative. So sea doesn't see negatives.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah, yeah. Yeah, you should write salmon, sharks and other predators because I I don't want to like speak longly, but yes. Are they? I feel like. Can find out what they are, just not. Yeah, yeah. And I would say pink salmon. Like, why did you? Why did you put natural origin there? I would say.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I2: First I just had natural origin and hatchery salmon and then you started talking about pink and Chinook. That's what I wanted to ask you. If this is correct and then when you mentioned hatchery salmon, which feasting? Can also just make this like broad, wild and hatchery.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah. No, I think. I think that I think it's, I guess I would. I would just say hatchery salmon generally OK, sorry pink salmon generally because. Because. I think there's so many hatchery, hatchery, pink salmon right now. The ones who are driving. The impacts so, but I would say that I would say right here that this makes sense. The tribes to the to the hatcheries make sense. And yes, and this is the. Yes. So that makes a lot of sense. I guess I would just put pink salmon around themselves and not specify. I would put but I like how you specified Chinook salmon natural origin here. That's what we're recovering too. We're not recovering pink salmon because they're not using listed, but we are recovering Chinook salmon, but we're only recovering natural. Fish, yes. So yeah, so I. I like how you have that. I mean, maybe someday, but OK, not not yet. Not quite yet. Yes. And I mean Chinook salmon. I've heard also nutrient enhancement. Would say. And. Yep, marine survivals for both. That's good. Or you can put turns and like and like turns and like other you could do turns and whales. And that's the thing. Is that, like everything basically from zooplankton to this paper, his papers literally called like. From diatoms to humpbacks like pick salmon are impacting The marine environment.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Yeah, and that's so. Like, that's why you know this area, you know, we're building these models because we're trying to understand from web dynamics and then if and how that's considered by diversity and how it needs to be incorporated into biodiversity for more holistic approach. This is super helpful because we don't always like a lot of people. Always. Think about the system dynamics this way and this is like we're trying to get specific. And understand how that is.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I2: Yeah. Normally it's just been OK salmon in general. Yeah. So I want. I want to make sure all of these dynamics are right. Does everything else. That was really the main questions I had. But does everything else. That makes sense. Based on this, we said, OK, cool.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Do you wanna show some of the scenarios? So I think maybe you might be interested with like we think of. This is almost more of like a qualitative like human dimensions perspective of like an MSE. And so we can like run. Can use this. Why we use it is we can run. Simulate scenarios. It's a little trade off management trade-offs.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I2: Yeah. So The software gets a little janky when you try to do the scenario analysis, so if we. I don't know. Say we. Increase the diversity of salmon just in general. What Would happen. So you get like a moderately positive effect. These numbers are just relative to each other. Yeah. Moderately positive increase in the fishing industry benefits portfolio effect is high. Small increase in resilience. This is like validating and consistent. But when we do a collaborative model, we have multiple people's perspectives. Then we may find unintended consequences, and some of these things.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: I look at the trade-offs like you were saying with MSC and actually since we have like 5 or 10 minutes. And you do do some of this like trade off work. Maybe. Sarah, we should. See if we can add Some weights.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: So one thing that can kind of make this approach more semi quantitative is we can add weights to those relations. Those weights right now are just binary like yes or no, positive or negative. But we can also add relative weights to them and that helps make the scenario simulations. Umm, you know a little bit more specific. So right now Sarah probably has some set to like one, but we will do like low, medium or high category and this is relative to Understand which components and relationships are driving system dynamics. Are there any relationships here that? Are maybe higher than others or like a really high relationships that we should specify that. It's a hard question.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah. I mean, I feel like the things we talked about are all pretty high. Like all of these are like, I mean, that's the thing too is like, there's also a lot of, like, there's also a lot. Studies still on how high these are. Yeah. We haven't agreed. You know, there's still a lot of, as I said, that's why I was like, we know a lot about salmon, yet there's still a lot of disagreement. I would say a lot of some people are like pink salmon are not a big deal because like, as I said Alaska fish and. Game does not want to hear about Pink Salmon yet, so they would like, turn that down and so would aquaculture. People from southeast Alaska, Prince William Town, because they're, like, I don't want to. I mean, there's, I said. Like there's. There's maybe more uncertainty about salmon. But like again, someone published a paper saying that, like going through all. The Things that it does. But we don't really know that super well. There's other. In some of our modeling, it looks like you know like. Like, I mean, obviously seals eat fish but. Like it matters less than just the general, you know, ocean conditions like up, well, lean and. Temperate overall like sea surface temperature and so sea surface temperature is really this huge and up. You know ocean conditions are are it seem like they're much stronger than a lot of other things. And so like maybe that should have the high, the ice and everything else should. Be Lower. The problem is is. That's not really a mechanism like if we're talking about like how we as managers can try to salvage. We Can't turn to. Surface temperature can't turn upwelling.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[I1: Now that's great how you just described, like how managers you know or those in aquaculture would like turn down the effects of pink. Like, that's exactly what we use this tool to quantify. Look at individuals, perspectives and how they would weight these relationships different and then we use this in a workshop setting as. Collaborative tool. To kind of tease out those perspectives and trade-offs, so that was like exactly how we would approach that technique.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)

[BD084: Yeah, it's been interesting. 'cause. I'm working on this paper on reuse rival with a person who works for a tribe and he does not want to talk about hatchery releases and he does not want to talk about pink salmon. He wants to talk about how it's all driven by large scale ocean conditions. It’s not something we can control.](https://onedrive.live.com?cid=35262dc0995d5aad&id=35262DC0995D5AAD!s741c492400c641c8a1d50c01fbde3582)