

WASHINGTON COASTAL MARINE ADVISORY COUNCIL MEETING

Wednesday, March 17, 2021 9:00 am – 12:30 pm

WEB-EX ONLY: Web-Ex instructions are included at the bottom of the agenda

AGENDA

Please try to call-in around 8:45 so that everyone can be online and ready to go by 9:00. **The meeting will start promptly at 9:00 a.m.**

Time	Agenda Item (Action items are marked with "I")	Objective (Information, Discussion, Action?)	Presenter(s)
9:00* (10 min)	Welcome & Introductions, Agenda Review <ul style="list-style-type: none"> Welcome and Introductions Review agenda ! Adopt summary of December meeting 	Information Reference Materials: <ul style="list-style-type: none"> Agenda Draft December Meeting Summary 	Crystal Dingler, WCMAC Chair Susan Gulick, Facilitator
9:10* (35 min)	Updates <ul style="list-style-type: none"> MRC Updates, Agency Updates, General Coastal Updates, MRAC update Budget update Coastal Workshops (economic and resilience) 	Information	WCMAC Members Susan Gulick, Facilitator
9:45* (30 min)	Eco-system Indicators <ul style="list-style-type: none"> Presentation of results from modeling efforts Discussion 	Information Reference Materials: <ul style="list-style-type: none"> Executive Summary QNM QNM Workshop Summary 	Robert Wildermuth, WCMAC Contractor
10:15* (30 min)	Overview of Invasive Species <ul style="list-style-type: none"> Overview of the WA Invasive Species Council and their Work Opportunities for collaboration between the two councils Discussion and Next Steps 	Information, Discussion, Action Reference Materials: <ul style="list-style-type: none"> List of Reference Materials Regarding Invasive Species 	Justin Bush, Executive Coordinator, WA Invasive Species Council Susan Gulick, Facilitator
10:45*	10 Minute BREAK		
10:55* (35 min)	Update on Economic and Coastal Hazard Resilience Work <ul style="list-style-type: none"> WA COVID recovery and connections to coast Update on coastal resilience efforts <ul style="list-style-type: none"> Economic Coastal hazards Next steps 	Information, Discussion Reference Materials: <ul style="list-style-type: none"> Coastal Economic/Hazard Resilience Update 	Dan McConnon, OFM Rod/ Fleck, Vice Chair Jackson Blalock, WA Sea Grant Mike Chang, Cascadia Susan Gulick, Facilitator
11:30* (30 min)	Offshore Aquaculture <ul style="list-style-type: none"> Implementation of Federal Executive Order Implications in on WA Coast Discussion 	Information, Discussion Reference Materials: <ul style="list-style-type: none"> Aquaculture Opportunity Areas Aquaculture Opportunity Area Educational Video 	Dan Tonnes, NOAA
12:00* (20 min)	WCMAC 2021-23 Steering Committee and Workplan <ul style="list-style-type: none"> ! Approve By-Law Change to allow ! Approve proposed Steering Committee membership Discuss 2021-23 Workplan 	Discussion, Decision Reference Materials: <ul style="list-style-type: none"> Proposed By-Law Change 2021-23 Workplan 	Susan Gulick, Facilitator
12:20* (5 min)	Public Comment	Information	Public/Observers Susan Gulick, Facilitator
12:20* (5 min)	Closing/Next Steps <ul style="list-style-type: none"> Reminder of Dates and Times for Future Meetings <ul style="list-style-type: none"> Agenda topic suggestions Other issues or announcements 	Information	WCMAC Members Susan Gulick, Facilitator
12:30*	Adjourn		Crystal Dingler, Chair

* All times are estimates and subject to change.

Upcoming WCMAC Meeting
Wednesday, June 16, 2021

WEB-EX INSTRUCTIONS

Click here to join the meeting: <https://cascadia.webex.com/cascadia/j.php?MTID=m9f095260ca0102e56ef916754195685b>
Meeting Number: 133 764 5739

Password: wcmac2021

Join by Phone: 1-650-479-3208

Access Code: 133 764 5739

WASHINGTON COASTAL MARINE ADVISORY COUNCIL MEETING

Draft Summary

Wednesday, December 9, 2020 8:45 am – 12:30pm

All meeting materials and presentations can be found on the WCMAC website:

<http://www.ecy.wa.gov/programs/sea/ocean/advisorycouncil.html>

Highlights

- Presentations about European Green Crabs and Seabed Mining.
- Discussion on the proposed recommendation on CZM certification of Pacific County SMP Section 6.
- Update on the coastal economic resiliency workshop.
- WCMAC Chair and Vice Chair Elections.

Summary of Decisions

- ! Tabled proposed CZM recommendation for future meeting.
- ! Consensus to send European Green Crab letter to Governor and legislators.
- ! Crystal Dingler was elected as Chair and Rod Fleck was elected as Vice Chair.

Follow-up Items

- Garrett Dalan to lead subcommittee to revise CZM recommendation language.
- Steering Committee to finalize at-large steering committee
- Susan Gulick to revise 2021 Workplan

Upcoming Meetings

- Wednesday, March 17, 2021
- Wednesday, June 16, 2021

Meetings will be held virtually unless otherwise noted.

Council Members Present

Brian Sheldon, Shellfish Aquaculture	Jennifer Hennessey, Governor's Office
Corey Niles, WDFW	Larry Thevik, Commercial Fishing
Crystal Dingler, Citizen	Mara Zimmerman, WA Coastal Salmon Partnership
Dale Beasley, Commercial Fishing	Mike Cassinelli, Recreational Fishing
David Fluharty, Educational Institution	Mike Rechner, DNR
Doug Kess, Pacific MRC	Randy Lewis, Ports
Garrett Dalan, Grays Harbor MRC	Rich Osborne, Science
Genevra Harker-Klimes, Coastal Energy	Rod Fleck, North Pacific MRC
Gus Gates, Recreation	Rich Doenges, Dept. of Ecology
Jay Carmony, State Parks	RD Grunbaum, Conservation
	Russell Callender, WA Sea Grant

Council Members Absent

Alla Weinstein, Energy	Todd Souvenir
Joshua Berger, Dept. of Commerce	VACANT, Economic Development
VACANT, Shipping	

Others Present (as noted on the sign-in sheet)

Aaron Tam, Cascadia Consulting	Kate Litle, WSG
Alex Stote, WA Sea Grant	Katie Wrubel, NOAA
Allen Pleus, WDFW	Kevin Decker, WA Sea Grant
Bobbak Talebi, Dept. of Ecology	Mike Chang, Cascadia Consulting
Brian Lynn, Dept of Ecology	Mike Comman, Westport Seafood Inc.
Casey Dennehy, Dept. of Ecology	Nansen Malin, Sea Resources
Chelsey Buffington, WDFW Presenter	P. Sean McDonald, UW
Henry Bell, Dept of Ecology	Sarah Griffin, Seattle Aquarium
Jackson Blalock, WA Sea Grant	Susan Gulick, Sound Resolutions, Facilitator
Jennifer Hagen, Quileute Tribe	Tommy Moore, NW Indian Fisheries Commission
Joe Schumacker, Quinault Indian Nation	

Welcome and Introductions

Susan Gulick asked for edits to the previous meeting summary. None were made, and minutes were approved.

Coastal Updates

Marine Resources Committee (MRC) Updates

- There is a new information campaign by Marine Resources Committee to support local fisheries with signage.
- Rod Fleck discussed amendments to grant awards to allow some of the educational recipients to continue with projects in a post-COVID environment. There were student interactions and discussion on what could be done online and offline.
- Rod also shared the issue associated with the **WDFW [emergency rule change to the coastal steelhead](#)** (hatchery and wild) and expressed concern regarding significant adverse economic impacts on the sports fishing community and businesses, including all aspects of our tourism sector in the midst of winter.
- Doug Kess mentioned that the Pacific County Board of Commissioners is working with Governor on CZM. There are signs of progress.
- Larry Thevik talked about how COVID has severely impacted crab fisheries. The levels of domoic acid in crab and clam is above 30 parts per million (ppm) which has necessitated the closure of all Washington crab fisheries. Uncertain about when domoic acid levels will drop.
- Jackson Blalock shared in the chat that videos and presentations from the MRC Summit that can be found [here](#).

Agency Updates

- Bobbak Talebi shared that **the Washington Coastal Zone Management Program Enhancement Strategy** is open for public comment (which was emailed to WCMAC members).
- Rich Doenges shared that the algae blooms have ended, but **domoic acid is still concentrated in crabs**. He is hoping that it will wash itself out eventually.

Budget Update

- Jennifer reported that the budget has been managed by the Department of Natural Resources in the past, and now, it will be shifted over to the Department of Ecology. Rich asked if the budget level would remain the same. Jennifer stated that she cannot disclose that information prior to the public release of the Governor's budget.

Coastal Economic Resilience Workgroup Update

- Bobbak updated the Committee on how Rod Fleck and Crystal Dinger have led the development of a series of webinar workshops to address different key components of economic resilience on the coast. The next workshop is tomorrow. The web platform worked surprisingly well and the conversation was very informative. These workshops are building knowledge and leading to recommendations for economic resilience investments along the coast. Bobbak expressed concern that only six WCMAC members attended the last webinar.
- Crystal commented on how the speakers were very knowledgeable. She appreciated that WCMAC had an opportunity to do this.
- Rod Fleck praised Mike Chang and Bobbak Talebi for their assistance and behind-the-scenes work. Tomorrow's talk will be about carbon sequestration, milling, community forests, and niche markets. There will be a link to watch the presentations once they are done.
- Bobbak encouraged WCMAC members to fill out the follow-up surveys after the workshop.
- There are no major updates on ecosystem indicators. The spring meeting will have a more comprehensive update for WCMAC.

Proposed Recommendation from Dale Beasley: *WCMAC recommends that the Pacific County SMP, Ocean Section 6, receives Coastal Zone Management Certification*

Discussion prior to the proposed recommendation:

- Susan reviewed the operating procedure for submitting recommendations that WCMAC adopted in 2014. The recommendations reviewed today followed this procedure, but the 45-day deadline prior to meeting was not met. Explanation was provided for why to still consider despite the missed deadline. There is opportunity to change the operating procedure for recommendations if WCMAC desires.
- Garrett Dalan: WCMAC hasn't dealt with recommendations recently, but this is one of our roles.

Dale Beasley presented the context and request outlined in the document he submitted to WCMAC for consideration. He highlighted a few key issues and restated his request.

Discussion after the presentation:

- Brian Lynn provided a brief summary of efforts to address Dale's concerns to date, which included:
 - Ecology and NOAA prepared and delivered a three-hour workshop about Federal Consistency to WCMAC in September. In response to this workshop, Ecology has been following-up with what was agreed upon as the path forward for looking at the SMP in the context of WA's CZM Program.
 - Ecology staff met with the Pacific County Commissioners, County staff, and a few interested parties to discuss Ecology's offer to work with County staff and other interested parties to carry out a detailed review of the Pacific County SMP against the existing federally-approved state enforceable policies in WA's CZM Program. The purpose of the review will be to determine if there are potential SMP policies/provisions that: 1) are not duplicative of existing Enforceable Policies; 2) meet the federal definition of Enforceable Policies; and 3) could be submitted as Enforceable Policies for NOAA's approval. Ecology will prepare the materials needed to conduct this review and will set up a meeting that works for all parties.
 - Ecology clarified that there are many ocean-related provisions throughout the Pacific County SMP. Ecology staff have been spending a significant amount of time working on this request and are in the process of developing a table that will outline the relevant Pacific County SMP policies and compare them to state-level policies from the SMA, the SMA regulations, ORMA, and the Marine Spatial Plan. If the group and the County only want to focus on two policies within the SMP, it would be helpful to clarify before we go any further.
 -

- There was general support for the intent of the recommendation (to address adverse impacts of certain ocean activities on Washington communities and resources), but skepticism regarding the written language. Garret suggested revising the recommendation under a subcommittee that he will lead. There was agreement with this suggestion.

European Green Crab Presentations

A suite of speakers gave presentations on European Green Crabs (EGC). The presentations are available on the [WCMAC Webpage](#).

Allen Pleus from Washington Department of Fish and Wildlife (WDFW) gave a presentation that gave an overview on EGC Management. Key points are:

- EGC management objectives include:
 - Collaboratively manage the EGC response
 - Prevent human-mediated European Green Crab (EGC) spread
 - Detect EGC presence at earliest invasion stage
 - Rapidly eradicate or reduce newly detected populations
 - Conduct research to develop increasingly effective adaptive management strategies
- WDFW went to legislature and legislature provided \$780,000 total with money going to WDFW, Lummi, Makaw, and Washington Sea Grant.
- 2020-21 Proposed Response Actions include assessing scope and scale of EGC and continuing reduction of EGC in Lummi Bay, Drayton Harbor, Dungeness Spit, Makah Bay, Salish Sea Region, and Coastal Region. Salish Sea Policy Coordination through a Puget Sound Partnership task force and Coastal Policy Coordination through WCMAC will also oversee response actions.
- COVID, social and political unrest, and west coast fires made EGC management more difficult
- Gaps include:
 - Uncertain funding after June 2021.
 - Work with state/federal/local government partners, tribal co-managers, stakeholders on setting 2021 priorities and planning
 - Looking at developing a coastal EGC action plan and updating the Salish Sea Transboundary Action Plan.
 - Develop MOUs as necessary for specific action areas.

Emily Grayson from Sea Grant and Chelsey Buffington from WDFW gave a presentation on EGC 2020 Coastal Field Season and Risk Summary. Key points are:

- EGC in WA move like a conveyor belt moving north from the south from Oregon and California. They have not reached Alaska yet. **EGC have a generalist diet and are durable.** They damage shellfish and eelgrass.
- Back in 1998, EGC were detected in Willapa and Grays harbor only. There trapping efforts from 1998-2002 with help from the Makah tribe.
- A WDFW employee was contracted recently to trap green crabs every year.
- 2020 Assessment: WDFW, WSG, and Tribal partners helped with multiple trapping strategies. The results were 37-443 crabs per 100 traps. Removed over 2000 EGC in Willapa Harbor.
- From 2001-2016, oceanography protected WA, but from **2016-2020 El Nino swept EGC along WA shores.**
 - There is connectivity between EGC, but they are not continuously connected.
 - In coastal estuaries they arrived earlier and are more widespread, more numerous, and are exposed to larger predators.
 - In Salish Sea, they arrived more recently and in isolated populations, relatively low numbers, and are protected by the Strait.

- A Transboundary EGC Action Plan was created but **no Coastal EGC Management Plan has not been completed**. Elements of the Salish Sea Transboundary Plan are not all transferrable to a Coastal EGC Management Plan.
- Statewide EGC Management activities face a **funding cliff after 2021**.

Adrienne Akmajian from Makah Fisheries Management gave a presentation on the 2020 Season & Concerns. Key points include:

- Discovered the crabs in 2017 and deployed over 4000 traps to captured over 3560 EGCs.
- **Primary concerns with EGC include:** impacts to bivalves, shellfish harvest, eelgrass, impacts to Dungeness crabs, evidence that EGC could increase with ocean warming.
- Makah have done trapping in 2 coastal rivers and Neah Bay. Secured grant funding in 2018 to work with staff with other agencies.
- 2020 efforts: 2-3 staff only and switched to mostly shrimp traps which were very effective. 200 crabs captured per 100 traps set. May need to reduce trapping from every 2 weeks throughout the summer to monthly and monitor how EGC are impacting local species.

Brian Sheldon from the Northern Oyster Company gave a presentation on Shellfish Grower concerns. Key points include:

- Saw EGC on an oyster seabed that was reported by WDFW. Frustrated that the approach is management instead of eradication.
- Shellfish are like an agricultural sector. RCW requires WDFW and Dept of Agriculture to address these kinds of pest management issues, but the Department of Agriculture is not mentioned in the letter from WCMAC.
- EGC eat everything and take everything out. Applaud Sea Grant and WDFW for their work but shellfish invasive species management is a necessity. Shellfish Growers have been working with Sea Grant and WDFW since 1990s.

Russell Callender from Washington Sea Grant gave a presentation on EGC. Key points include:

- Management actions along inland shorelines are currently guided by the Salish Sea Transboundary Action Plan, and a plan is still needed for EGC along Pacific Coast shorelines. He supports the WCMAC recommendation requesting the governor and state legislature convene a policy forum in order to provide policy-level advice on the management on the highly invasive EGC and develop and coordinate management plans for the Pacific Coast and Salish sea.

European Green Crab Recommendation Letter

Susan gave an overview of **the invasive EGC letter to Governor Inslee**. The group asked that the letter advocate for eradication in addition to management. Susan will also include Crystal as the newly elected chair, along with Garrett as the outgoing chair.

Discussion:

- Brian Sheldon (chat): Just wanted to let everyone know that in regard to the proposed recommendation on green crab I've delivered some suggested edits. Per RCW 77.115.010, WDFW is required to work jointly with WSDA to address these type invasive issues. Shellfish are an agricultural sector and as such are part of the WSDA family. The reason WSDA is included in dealing with this type of invasive is because of the massive impact on agricultural sectors, and the agency has well developed pest management resources that can react to these type emergency pest matters. I've offered amendments geared to include WSDA as a partner in eradicating green crab. We want an eradication program. The urgency is the most important part to convey.

- David Fluharty (chat): I would recommend that the Governor place on the agenda of the West Coast Governors Ocean Council an action to block the continuing source of invasive green crab larvae in Oregon and California. Without increased concerted West Coast collaborative work we will always remain in a reactive mode.
- Kate Litle: I would include a recommendation for 5 seasonal technicians in the request.
 - Susan: Draft that was sent a week ago included budget request, but this letter just asks for a policy forum right now and leaving it up to the agencies, legislature, and governor on how to make that happen. This is an outcomes-based recommendation instead of telling them how to achieve the outcome.
- There was debate about whether eradication was possible, but there was general agreement that eradication should be the goal. Russell Callender dissented saying that eradication as the only management approach is limiting and suggested management and control.

EGC Letter (amended with adding eradication and Crystal) was approved by consensus with no dissent.

Seabed Mining Presentation (Tom Rudolph, Pew Charitable Trusts)

Tom Rudolph from Pew Charitable Trusts gave a presentation about seabed mining. Key points include:

- Seabed mining overview
 - Hard minerals vs sand, gravel, and shell. -Focus of our work is hard minerals
 - Nearshore vs deep sea mineral deposits- focus on nearshore
 - Traditional/artisanal vs industrial- focus on industrial
 - Existing vs new
- **Impacts from seabed mining** include noise pollution, destruction of sea floor biota and habitat, and sediment-related impacts, temperature-related impacts, spatial conflict with ocean stakeholders.
- Pew's U.S. Campaign focused on protection in the most vulnerable areas like state-managed waters. Focused on the most invasive potential activity (hard mineral exploration and extraction)
 - Oregon banned seabed mining 20 years ago
 - Deep-sea minerals include zinc, nickel, cobalt, gold, silver, rare earth elements
 - In nearshore areas- gold, iron, titanium, marine phosphorites used for fertilizer
 - **Information on seabed mineral mining is sparse.** A lot of research was done in the 1960s and 1970s that has not digitized yet. A lot of the literature talks about underestimation of seabed mining impacts
 - Some of the mining that is occurring is happening in state waters.
 - Washington policy/regulatory status is that minerals on or under the seabed are **under jurisdiction of WA DNR**. WA DNR accepts and considers lease applications for marine mineral extraction or prospecting on a case-by-case basis. **Other agencies involved via permitting** planning include **Dept of Ecology through the CZM Program, SMP and WDFW**.
- Questions:
 - David Fluharty (chat): Check out the MMS (federal agency) Draft EIS on Black Sand Mining off WA and OR 1982. One SMEA student did a thesis on this. None of this is digitized. DNR bans oil and gas drilling in state waters, including directional drilling from land.
 - Gus Gates (chat): If business owners are interested in signing on to a letter supporting a prohibition on seabed mining in WA state waters, [here](#) is the link.
 - Rich Osborne (chat): I think if we could outlaw it like Oregon, we should seriously consider supporting that.
 - Doug Kess (chat): Can we share this presentation recording with outside groups? I want to visit to visitor's bureau on Long Beach.
 - Jackson Blalock: Here is the link to the [MRC Summit recordings](#). It also has a recording on European Green Crab.

- Larry Thevik: You referenced that Oregon has a prohibition, and I would certainly wish WA did as well. Maybe we can move towards that. Wondering about your work on a federal level.
 - Tom: focus is at the state level and including Ocean Resources Management Act (ORMA). ORMA gives DNR existing authority to prohibit this activity. ORMA also provides things that give DNR additional authority. There are not enough tools to allow DNR to deny seabed mining entirely (e.g. case of lawsuit in Mexico).

WCMAC Elections

Crystal Dingler was elected Chair and Rod Fleck was elected Vice Chair by unanimous decision.

Susan reminded that members-at-large should be nominated to the steering committee that balance geographic representation. Next step will be for steering committee to try to **finalize at-large members for steering committee.**

Questions and concerns on term limits:

Susan reviewed the membership with list with term expiration dates, which was distributed with the meeting materials. She explained that, according to the statute, the Governor does not appoint representatives of state agencies or MRC representatives, so these members do not have limitations on the length of time they can serve. For other members who are appointed by the Governor, terms are 4 years. The Governor may reappoint members for one additional term. Beyond the second term, members may continue until the seat is filled but they will not be reappointed for a third term.

- Rich Osborne: I couldn't find a replacement, but perhaps, I should just resign to open up the seat.
 - Susan: your position has expired, but the Governor encourages that you stay on until a replacement is appointed.
 - Rich: would be helpful for Governor to advertise this Science seat vacancy.
- Larry Thevik: I'm not sure where my term limit stands as well.
 - Susan: We can look into that and clarify.
- Mike Cassinelli- I thought I reapplied.
 - Susan: we will sort this out, but you are eligible for reappointment. The paperwork may not be current.
- Brian Sheldon: I find it a little offensive that people might be "booted off." I would like to see the governor's policy in writing from Jennifer for the 2 term limits for his councils.
 - Doug Kess: I believe that a 2-term limit will eviscerate WCMAC. I think the solution to the expired member issue is 2-part, one part is already in place. a) allow expired members to serve until a replacement is installed, and b) the governor's office advertises for a replacement, processes the applications, and finalizes the appointments.
- Susan clarified:
 - Members will not be "booted off", nor are they expected to find their own replacement.
 - Members are welcome and encouraged to serve until a replacement is appointed.
 - The Governor's office will seek replacements for seats but if anyone who has nominations of persons to fill vacant or expired seats, they should contact Susan, Bobbak or Jen, and/or encourage the person to apply.

March WCMAC Agenda

The workplan for 2021-23 will be discussed at the March meeting. Other potential agenda items include offshore aquaculture, erosion/dynamic revetment, ecosystem indicator modeling, proposed recommendations from economic workshop, proposed recommendations from coastal hazards workshop.

Susan asked if there were any additional items that we should consider for the March 2021 meeting:

- Dale: would like to see follow-up on the SMP Recommendation.
 - Susan: yes, and Garrett said he would convene a subgroup.
- Brian Sheldon: please add successful/unsuccessful invasive species management.

Public Comment

No public comment.

Other issues

- Upcoming meetings are March 17, 2021 and June 16, 2021.
 - Depending on the budget, we are hoping to have one meeting in the second half of 2021. The date will be determined after the budget is finalized.
- Susan announced that she is stepping down as the WCMAC facilitator when her contract expires on June 30, 2020.

Abstract and Executive Summary

Qualitative Network Analysis of New Ocean Uses in Washington State Waters

Abstract

The Washington Marine Spatial Plan process defines interactions of physical, ecological, and socioeconomic components of important marine habitat systems. Our work describes the structure and function of these systems to coordinate potential influences of new marine industry uses along the outer coast in state and surrounding federal waters. We apply Qualitative Network Modeling to the seafloor and kelp forest systems and evaluate potential direct and indirect effects of three prospective new uses: offshore wind farms, offshore finfish aquaculture, and seabed mining. We assess these effects in the context of global climate change. Qualitative Network Models rely on direct, linear interactions between variables in a network structure following conceptual models developed by subject experts. Results were interpreted as directional changes in each variable with one or more pressures applied to the system. The results indicated uncertain outcomes for many model elements of management interest, including habitats and managed rockfish groups. Seabed mining resulted in clear negative impacts to the kelp forest system. Positive outcomes were estimated for managed fish groups in both systems under wind farm and aquaculture scenarios (sablefish, crab and shrimp in seafloor, and salmon, black rockfish, and lingcod in kelp forest). Climate change increased uncertainty of outcomes in all new use scenarios. Our analysis provides a rapid method to determine initial risk to habitats from new uses in Washington's outer coastal waters and reveals ecological components for which new indicators may be developed to better assess the state and functioning of these systems.

Executive Summary

The Washington Marine Spatial Plan (MSP) coordinates development of marine industry along the outer coast in state and surrounding federal waters. To inform planning and development of these new marine use sectors ("new uses"), the Washington Department of Ecology initiated a study to evaluate risks of potential new uses in Washington's outer coast in the context of climate change. Here we evaluated the potential direct and indirect effects of three new uses through Qualitative Network Modeling (QNM). As an example, we demonstrate our methods on the seafloor and kelp forest habitat systems described in the MSP and the Ecosystem Indicators report (Andrews et al. 2015). The purpose of this modeling exercise was to identify data components that the state should prioritize, track, and report on over time, and to indirectly inform resource management decisions for the state, particularly decisions about changing ocean conditions and new ocean uses.

Conceptual models of each habitat outlined in the Ecosystem Indicators report (Andrews et al. 2015) were translated into directed networks describing the interactions of physical, ecological, and socioeconomic components. We convened the *Qualitative Network Modeling of Washington Ocean Habitats Workshop* to review and further develop the seafloor and kelp forest habitat networks over teleconference October 1st and 5th, 2020. A pre-meeting survey was used to prioritize variables affecting each habitat system and final model structures were revised given

workshop participant input and resources provided to study authors following the workshop. On Day 1 of the workshop, 29 participants were introduced to the QNM methods and divided into four break-out groups based on habitat expertise to discuss the survey results and edit preliminary model structures developed ahead of the meeting. On Day 2, Robert Wildermuth briefly demonstrated output from habitat models edited with respect to feedback from Day 1, and 31 participants provided further refinements to the model structures to align modeled dynamics with expert understanding. The resulting habitat network structures served as the basis for the assessment.

For each habitat network, we evaluated modeled responses under multiple climate change and new use scenarios using QNM. QNMs describe the nature of a link between elements (positive, negative, or no link), and the output gives a qualitative response of the system's elements (increase, decrease, no change) to each scenario, as well as the reliability of this response. We evaluated potential outcomes under three new use scenarios: offshore finfish aquaculture, offshore wind farms, and seabed mining. These scenarios were evaluated under current conditions and in the context of anticipated climate change.

In the kelp forest network, most physical environment and abiotic habitat elements were unaffected by increased temperatures and ocean acidification. There were uncertain outcomes for Hypoxia, with nearly 70% of simulations resulting in higher hypoxia levels under climate change. Fished stocks and other managed groups (e.g., Black Rockfish & Lingcod, Salmon, Sea Otters, and Young-of-Year Rockfishes) in the kelp forest system, as well as lower trophic groups, were estimated to have negative outcomes in a majority of climate change simulations.

Seafloor habitat was estimated to have reduced hypoxia under climate change. Most other abiotic environmental elements were also unaffected in the seafloor network, but Rock Habitat tended toward positive outcomes under climate change. Outcomes for seafloor fish groups were highly uncertain, with negative outcomes occurring more often for Small Prey, Slope Rockfishes, and Fishing.

Considering the new use scenarios, finfish aquaculture in or near kelp forest resulted in higher levels of Nutrients and Sedimentation in the absence of climate change, with possible increases in Forage Fishes, Black Rockfish & Lingcod, Mid-Trophic Fishes, Young-of-Year Rockfishes, and Salmon, among others. Rocky Reef was expected to decline in the kelp forest system, with uncertain outcomes for Kelp, Sea Urchins, Sea Stars, Sea Otters, and Hypoxia. The outcome responses to aquaculture under climate change were more uncertain, except for Kelp coverage which was expected to decline in this scenario. Offshore aquaculture in the seafloor system resulted in higher levels of Hypoxia, Pollution, and positive outcomes for Corals & Sponges, Sablefish, and Small Prey. Soft Habitat and Flatfishes were negatively impacted under the aquaculture scenario, with uncertain outcomes for Benthic Predators, Crabs & Shrimps, Shelf and Slope Rockfish groups, and commercial fishing. The outcomes for offshore aquaculture were more uncertain under climate change for managed groups in seafloor habitat, though Hypoxia was expected to be reduced under climate change due to declines in Zooplankton and Detritus & Bacteria. Declines in Fishing in this scenario resulted in positive outcomes for Rock Habitat.

Wind farms in or near kelp forest had beneficial outcomes for managed fish groups and recreational fishing. Negative outcomes were expected for Sea Stars and Rocky Reef, while outcomes were uncertain for Kelp, Hypoxia, and Sea Otters. Outcomes were less certain for wind farms with climate change for the same kelp forest model elements. Negative outcomes of wind farms were more reliably estimated under climate change for Black Rockfish & Lingcod, Kelp, Sea Otters, and Young-of-Year Rockfishes, and resulted in higher levels of Hypoxia. Wind farms in the seafloor system predicted increases in Crabs & Shrimps and Sablefish. Outcomes were more uncertain for other managed fish groups, Corals & Sponges, and Fishing in this scenario. Again, climate change combined with wind farms in seafloor habitat increased uncertainty in the outcomes for most model elements. In this scenario, Fishing, Slope Rockfishes, and Hypoxia were expected to decline.

In contrast to the other new uses, seabed mining was expected to negatively impact a majority of network elements in the kelp forest system. Hypoxia was expected to increase in this scenario, while outcomes for Sea Urchins, Sea Stars, and other Benthic Invertebrates were uncertain. Mining under climate change in the kelp forest system resulted in a greater number of negative outcomes for nearly all model elements. Seabed mining in the seafloor system model resulted in negative outcomes for Fishing, Flatfishes, Benthic Predators, and Soft Habitat. Hypoxia, Sablefish, and Corals & Sponges increased in this scenario, while outcomes were more uncertain for Crabs & Shrimps, Rock Habitat, and Slope and Shelf Rockfish groups. Mining in the seafloor system under climate change increased uncertainty in outcomes for all managed fish groups. Negative impacts on Fishing and Soft Habitat remained fairly certain in this scenario.

Our results are dependent on the modeling assumptions made while developing the kelp forest and seafloor system network structures and implementing the scenarios. For example, the seafloor system outcomes in scenarios incorporating climate change were affected by reductions in Zooplankton and resulting Detritus & Bacteria levels due to the combined negative impacts from Ocean Acidification and increased Seafloor Temperature. The kelp forest system scenarios were similarly affected by the bottom-up effects of lower trophic groups connecting physical and fish group elements. We recommend that Washington's Department of Ecology develop monitoring for zooplankton and forage fish in both systems to improve quantitative understanding of these dynamics and their effects on species of management, social, and economic interest. We also recommend monitoring highly connected elements with many network links, particularly Benthic Invertebrates (13 links), Kelp (16), and Zooplankton (12) in the kelp forest system, and Crabs & Shrimps (13), Small Prey (15), and Fishing (16) in the seafloor system. Our results can help guide ecosystem-based management of Washington's coastal resources and the methods can be applied to other Washington MSP habitat systems.

Summary of the Qualitative Network Modeling for Washington Ocean Habitats Workshop

Draft document prepared: November 18, 2020

by

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Workshop Summary

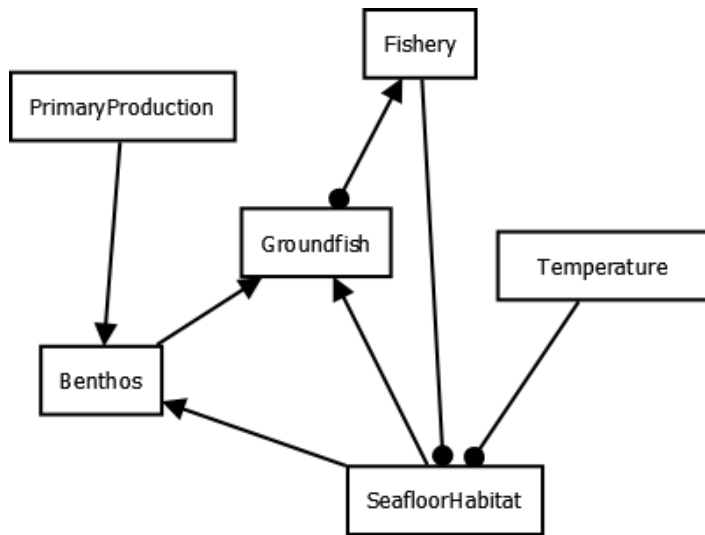
The Washington Department of Ecology contracted Robert Wildermuth of the University of Massachusetts Dartmouth to develop qualitative network models (QNMs) to help guide management decisions regarding new ocean uses and changing ocean conditions in the waters along the outer coast of Washington State. This project builds on the seafloor and kelp forest habitats conceptual models developed during the marine spatial planning process (Andrews et al., 2015). These models will be used to identify data components that the state should prioritize, track, and report on over time, and to indirectly inform resource management decisions for the state, particularly decisions about changing ocean conditions and new ocean uses. As a first step, the Washington Department of Ecology virtually hosted the Qualitative Network Modeling for Washington Ocean Habitats Workshop over Webex on the morning of Oct 1st and 5th, 2020. The objectives of the workshop were to:

1. Define the model structure of Seafloor and Kelp Forest Habitat QNMs for use in risk assessment of new ocean uses within the boundaries defined under the WA Marine Spatial Plan,
2. Include feedback from stakeholders and experts on relevant model elements, and
3. Increase understanding of model use and output among stakeholders and management bodies.

Experts in coastal Washington marine systems from state, tribal, and federal agencies, as well as academic institutions, were invited to participate in the workshop. Ahead of the meeting, participants were surveyed about their expertise and were asked to rank the importance of conceptual model components to system function and human wellbeing. On Day 1 of the workshop, 29 participants were introduced to the QNM methods and divided into four break-out groups based on habitat expertise to discuss the survey results and edit preliminary model structures developed ahead of the meeting. On Day 2, Robert Wildermuth briefly demonstrated output from habitat models altered with respect to feedback from Day 1, and 31 participants provided feedback to further refine the model structures in order to bring dynamics exhibited by the models in line with expert understanding of these systems. Participant feedback from the expert survey, meeting notes, and an exit survey, including additional data and resources, are summarized in the following report.

Description of the Modeling Approach

The Washington Department of Ecology will use outputs from qualitative network models for the Seafloor and Kelp Forest habitats described in the WA Marine Spatial Plan (Andrews et al. 2015) to identify data components that the state should prioritize, track, and report on over time, and to indirectly inform resource management decisions about changing ocean conditions and new ocean uses. Qualitative network models use a network to describe positive or negative relationships between model elements (e.g., Fig. 1). In the WA MSP Habitat models, the model elements include physical forces or states, ecological groups, or human activities, and the links represent interactions or drivers of change in one element due to changes in another. As a simplified example, in Figure 1, Temperature has a negative link (filled dot) to Seafloor Habitat because as Temperature increases, the quality of Seafloor Habitat for Groundfish and Benthos declines. On the other hand, Groundfish



benefit from good quality Seafloor Habitat and eat invertebrates in the Benthos, so those elements have a positive link (arrows) to Groundfish.

The relationships in the network can be represented as a community matrix where non-zero entries represent links between elements in columns and rows. Positive links are indicated with a 1, negative links with a -1. We can use matrix algebra to simulate the response of every element in the network if one or more elements is consistently increased or decreased with a press perturbation (Dambacher et al. 2002, Justus 2006). In our simple example, we can simulate a climate change scenario by applying a press perturbation to increase Temperature and recording the resulting responses on the other elements. In this

scenario, Seafloor Habitat, Benthos, Groundfish, and the Fishery are negatively impacted, but Primary Production is unaffected because no links are directed at Primary Production in the network (Fig. 1).

Scenarios using press perturbation of the qualitative network depend on three main assumptions:

1. **The system is stable**, meaning if one element is pressed, the levels of all elements will balance out at some new level, but no element goes to zero (i.e., no group goes extinct).
2. The relationships between elements are linear with some undefined, constant slope. This means all increases or decreases from the press perturbation scenarios are relative. **The model doesn't specify the magnitude of change from a scenario.**
3. Press perturbations represent a consistent change in one or more model elements until the system balances again. **The model doesn't describe how a model element gets to its new stable level.**

These models are qualitative because they only describe the quality of a link between elements (positive, negative, or no link), and the output gives a qualitative response of the system's elements (increase, decrease, no change) to each scenario.

Summary of Expert Survey Responses

Experts invited to the workshop were asked to provide information about themselves and their expertise in seafloor and kelp forest habitats through a survey before the first day of the workshop. A total of 17 experts filled out the survey, with a majority (10) having 15 or more years of experience working, living, and/or invested in Washington's outer coast. This resulted in a cumulative minimum of 183 years of experience in Washington marine systems and coastal communities among our respondents. Except for one respondent who preferred not to provide information on their gender, the gender ratio of respondents to the survey was relatively balanced, with a female to male ratio of 9:7. All respondents choosing to report their race and ethnicity were White or European without Hispanic, Latinx, Chicanx, or Spanish origin. The majority of respondents were marine resource managers or policy practitioners (6), employed by the federal government (7), and/or general experts on Washington's coastal ecology (7) (Table 1). We note that the survey allowed respondents to choose multiple

roles to better reflect the range of their expertise and therefore the total responses in Table 1 is larger than the number of respondents.

Table 1: Roles self-identified by survey respondents. Note: respondents were allowed to select more than one role and therefore the respondents self-identifying column sums to more than the total number of respondents (n = 17).

Role	Respondents self-identifying
Federal government	7
General expert in the ecology of coastal Washington	7
Marine resource manager or policy practitioner	6
Expert in climate change	4
State government	4
Expert in WA seafloor habitats	3
Expert in the oceanography or physical drivers of WA's marine systems	3
Non-tribal coastal community stakeholder	3
Marine recreation stakeholder	2
Expert in WA kelp forest habitats	2
Expert in ocean acidification	1
Tribal government or stakeholder	1
Aquaculture stakeholder or expert	1
Academia/Research	1

For each habitat (seafloor or kelp forest), experts were asked to identify the importance of each component or attribute identified in the respective conceptual model (Andrews et al. 2015). Components and attributes (hereafter model elements) were divided into physical drivers, ecological and fisheries elements, and human activities, and then scored from most to least important based on survey responses: Very Important (rank score of 3), Fairly Important (2), Somewhat Important (1), No Opinion (0), and Not Important (-1). We then calculated the cumulative rank for each model element as the sum of importance scores for that element. We also summarized the minimum and maximum rank given to each model element (Tables 2 and 3).

In the seafloor model, the Dissolved Oxygen physical driver had the highest cumulative rank of any model element (45), followed by Fishing (43) and Crabs (40) in the human dimensions and ecological and fisheries element types, respectively (Table 2). The lowest ranked model elements were Currents and Mid-Water Rockfishes, with a cumulative rank of 24 for each (Table 2). All model elements were scored as Very Important by at least one survey respondent, but the highest ranked elements also had the highest minimum importance score (Fairly Important, 2). Model elements with lower minimum importance scores (No Opinion, 0, or Not Important, -1) also tended to have lower cumulative ranks. We view this as evidence that the experts responding to the survey had a general consensus about which components and attributes of the seafloor habitat are most and least important. One exception to this conclusion may be the Forage Fishes element, which had a moderate importance rank (35), but also received at least one score of Not Important (-1) in the survey responses.

In the kelp forest model, Kelp Habitat received the highest importance score (45), followed by Nutrients and Rocky Reef Habitat, each with a score of 41 (Table 3). The lowest ranked model element was Marine Snow with a cumulative rank of 10, followed by Local Weather with a rank of 25 (Table 3). As with the seafloor model, every kelp forest model element was scored a maximum importance of Very Important (3) at least once,

however the minimum scores were less consistent. Again, the highest ranked model elements all had minimum importance scores of Fairly Important (2), but minimum scores of Somewhat Important (1), Not Important (-1), and No Opinion (0) were more evenly distributed among the remaining elements. Although the consistency in highly ranked model elements likely still serves as evidence of consensus among expert respondents on which elements are most important in kelp forest habitats, the wide range of importance scores for other elements may indicate more uncertainty in which elements play an important role in this habitat.

These survey results were reported to participants on Day 1 of the workshop and used to help frame discussion about changes to preliminary versions of the QNM model structures. We summarize these discussions and model edits in the next section.

Table 2: Total rank, minimum and maximum score for seafloor habitat model elements (n = 17).

Element Type	Model Element	Total Rank	Minimum Score	Maximum Score
Physical Drivers	Dissolved Oxygen	45	2	3
	Upwelling	39	1	3
	Ocean Acidity	36	1	3
	Seafloor Temperature	36	1	3
	Rock Habitat	35	0	3
	Soft Habitat	31	0	3
	Source Waters	27	0	3
	El Nino Southern Oscillation	27	-1	3
	Currents	24	0	3
Ecological and Fisheries	Crabs	40	1	3
	Benthic Invertebrates	39	0	3
	Phytoplankton	38	1	3
	Zooplankton	37	1	3
	Forage Fishes	35	-1	3
	Corals	34	0	3
	Deep Targeted Rockfishes	34	0	3
	Benthic Predators	33	0	3
	Flatfishes	32	0	3
	Groundfish Assemblage	32	0	3
	Shelf Rockfish	32	0	3
	Trophic Structure	31	1	3
	Marine Snow	27	-1	3

	Mid-Water Rockfishes	24	-1	3
Human Activities	Fishing	43	2	3
	Seafood Demand	33	1	3
	Pollution	28	0	3

Table 3: Total rank, minimum and maximum score for kelp forest habitat model elements (n = 17).

Element Type	Model Element	Total Rank	Minimum Score	Maximum Score
Physical Drivers	Nutrients	41	2	3
	Rocky Reef Habitat	41	2	3
	Sea Surface Temperature	39	2	3
	Upwelling	32	0	3
	Dissolved Oxygen	30	1	3
	Sedimentation	30	1	3
	El Nino Southern Oscillation	29	-1	3
	Ocean Acidity	28	1	3
	Currents	27	-1	3
	Source Waters	27	0	3
	Local Weather	25	0	3
Ecological and Fisheries	Kelp Habitat	45	2	3
	Sea Urchins	39	0	3
	Forage Fishes	37	-1	3
	Sea Otters	34	-1	3
	Trophic Structure	34	1	3
	Young of year Fishes	34	0	3
	Zooplankton	33	1	3
	Benthic Invertebrates	31	0	3
	Black Rockfish	31	0	3
	Phytoplankton	30	-1	3
	Mid-Trophic Fishes	28	0	3
	Marine Snow	10	-1	3
Human Activities	Pollution	33	1	3
	Recreational Fishing	29	1	3

Summary of Workshop Discussions and Model Structure Edits

On Day 1 of the workshop, after reviewing the QNM modeling approach and responses to the expert survey, workshop participants were divided into four breakout groups according to their expertise in a particular

habitat or system (two groups per habitat). These breakout groups were facilitated by the workshop hosts and notes were recorded with the help of rapporteurs from the Coastal States Organization, the University of Washington, and University of Massachusetts Dartmouth. Group facilitators were directed to guide discussion of their respective habitat models around elements of the models that are important for management directives, ecosystem services, or wellbeing. We also asked participants to suggest new model elements or relationships between elements based on their experiences and available data sources. Group facilitators guided discussion around which relationships between elements were strong enough or relevant for representing system dynamics, and thus important to include as positive or negative links in the network. Discussion on Day 2 of the workshop was used to review changes made to model structures based on breakout group edits, suggest further changes, and identify remaining gaps in understanding and additional resources that may fill those gaps. Finally, respondents were asked to provide feedback about the workshop through an exit survey, where they were provided another opportunity to suggest edits to the model anonymously. Below we summarize the suggestions for changes to model definitions and structures based on responses in both surveys, notes from the breakout groups, and discussion from Day 2 of the workshop.

Seafloor Habitat Model Changes

The first set of changes to the seafloor habitat model involved renaming and redefining some physical driver and lower trophic elements. The Source Waters element was re-defined as Subarctic Water Mass to better distinguish the relationship between this water mass and zooplankton communities from faster (i.e., intra-annual scale) physical drivers in the coastal Washington system. We also redefined Dissolved Oxygen as Hypoxia to improve interpretation of risk to the system from low oxygen (increased hypoxic) events. The Hypoxia redefinition also required changing the nature of links originating from this element to reflect the unfavorable nature of effects from increased hypoxia. Lastly, the function of bacteria in the system necessitated that this biomass pool be transferred to the detritus group (changed from Marine Snow), resulting in newly defined elements of Phytoplankton and Detritus & Bacteria.

Multiple links between new and existing elements were edited. Effects of Ocean Acidification were removed from mobile fish groups, assuming that these groups could relocate to better habitat temporarily. Negative Ocean Acidification impacts were included for shelled invertebrate and structural groups, including Crabs & Shrimp, Zooplankton, and Corals & Sponges. The link between Ocean Acidification and Detritus & Bacteria was also removed. The breakout groups also decided to remove links from Hypoxia to Corals & Sponges, from Seafloor Temperature to Rockfish, and from Subarctic Water Mass to Ocean Acidification. Positive links were added from Zooplankton to Benthic Invertebrates and Flatfishes, from Detritus & Bacteria to Benthic Invertebrates and Corals & Sponges, and from Soft Habitat to Flatfishes. A negative link was added from Benthic Predators to Deep Rockfishes. Negative Fishing impacts on Rock Habitat were added, which then had a positive impact on Corals & Sponges. Workshop participants also added the positive pathway from Zooplankton to Detritus & Bacteria to Crabs & Shrimp.

To simplify the model, multiple element removals were discussed. Shelf Rockfish were removed, as was recommended for Mid-Water Rockfish. After discussion, Forage Fish were suggested to be redefined as Small Fish, which reflects mesopelagic fish at depth as opposed to more surface-oriented species and provides a link between invertebrates and higher trophic levels. One breakout group discussed removing Rock Habitat from the model to narrow the scope of the model specification to describe soft bottom habitats where most current human activities overlap. The workshop organizers decided against this tack because the models were meant to be generalizable for all seafloor habitat effects, particularly in the case of new uses which may impact Rock Habitat more. Rock Habitat was also retained to reflect the designation of these habitats as Essential Fish Habitat for some rockfishes.

Given the redefinition of physical drivers model elements and output from two simple climate change scenarios (Seafloor Temperature warming and increased Ocean Acidification), workshop participants suggested the following refinements of the physical drivers sub-system to possibly better reflect expert understanding of these dynamics and the patterns of hypoxia, warming, and acidification observed in the system. Positive links from Upwelling to Hypoxia and Ocean Acidification were included to reflect the intra-annual linkages between these phenomena. A positive link from El Niño Southern Oscillation to Subarctic Water Mass was added, as well as a link from Detritus & Bacteria to Hypoxia to reflect eutrophication. Currents, Eddies & Plumes were removed from the seafloor habitat model because they were likely not of large influence at these depths.

Further, the seafloor habitat experts chose to simplify representation of the biogeophysical process surrounding lower trophic interactions in waters below 30 m depth. Rather than reflect the process of primary production, which occurs in surface waters, Phytoplankton was removed from the model, with a positive link included directly from Upwelling to Zooplankton to reflect the effect of upwelling-driven blooms on grazing and export of biomass and detritus to depth. Justification for the elements and links, with associated references, are logged in the data dictionary that accompany the final model used for analyses.

Based on discussions during the second day of the workshop and the exit survey, the following topics need further clarification in the seafloor habitat model definition:

1. Workshop participants expected a negative impact of the El Niño Southern Oscillation on Upwelling, resulting in reduced upwelling in high ENSO phases. Further clarification may be found in Jacox et al. (2015).
2. Based on preliminary scenarios, the model does not reflect the expected correlation between Hypoxia and Ocean Acidification. This may be possible to correct with a connection from Detritus & Bacteria to Ocean Acidification. Workshop participants suggested conferring with Simone Alin about the PMEL OA cruise in 2016 to confirm about the relationships between ENSO, warming, OA, and hypoxia, along with Marshall et al. (2017) and Hodgson et al. (2018).
3. Related to (2) above, it may be helpful to include a model element reflecting marine heatwaves in the system.
4. It was recommended in multiple contexts that sablefish should be separated from the Benthic Predators. One breakout group suggested possibly defining a DTS (Dover sole, Thornyhead, and Sablefish) Complex element, which all have similar tolerance to hypoxia, as well as management relevance. This may require re-inclusion of the Shelf Rockfish element.
5. Forage fish, particularly mesopelagics, were identified as important with potential to include them as a Small Fish element. Evidence for links to these fish was provided in Koehn et al. (2016) and supporting material.
6. Respondents to the pre-meeting survey suggested we consider adding other benthic structure-forming organisms as a separate element.

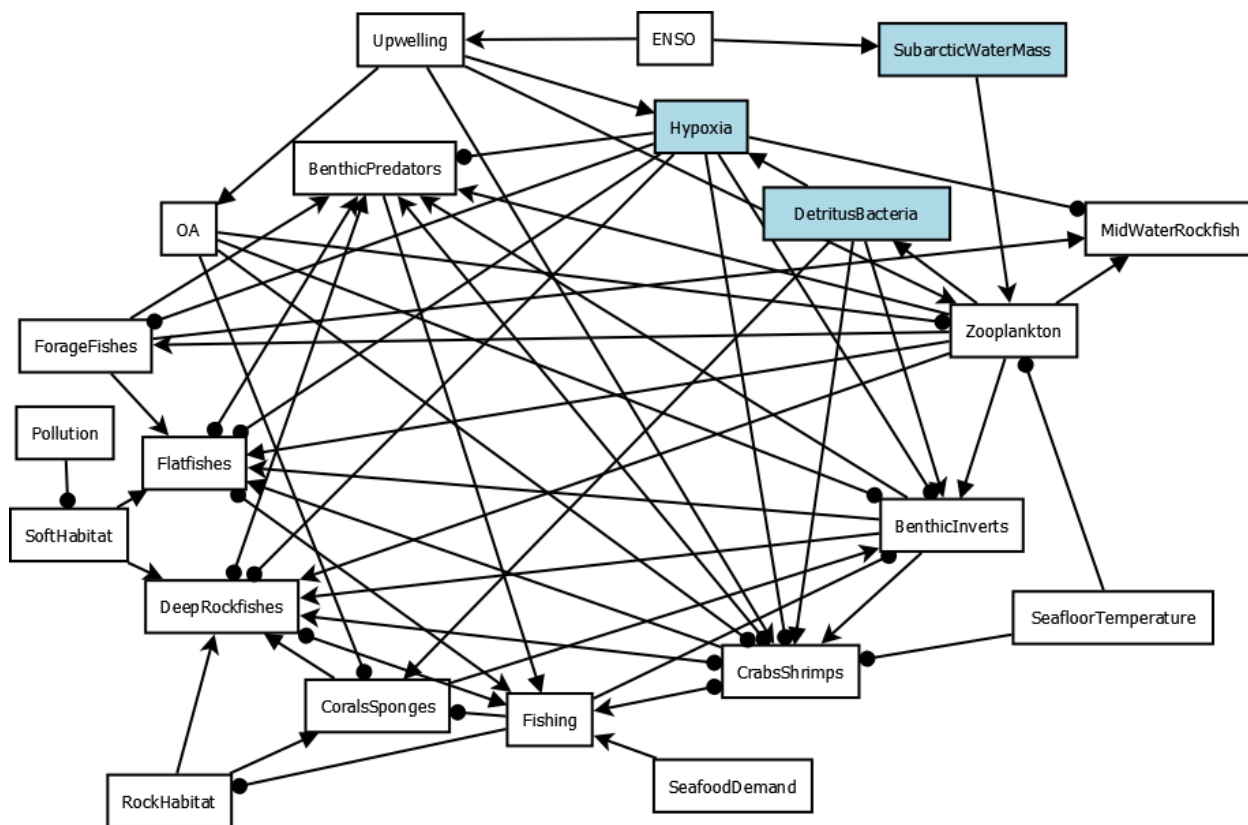


Figure 2: Edited seafloor habitat network presented on Day 2 (Oct. 5th) of the workshop. Blue elements are elements redefined following breakout groups.

Kelp Forest Habitat Model Changes

The redefinitions for Phytoplankton, Detritus & Bacteria, Subarctic Water Mass, and Hypoxia defined for seafloor habitat above were also implemented for the kelp forest model. In addition, the Local Weather model element was redefined as Storms to improve interpretation. A Commercial Fishing model element targeting Lingcod & Black Rockfish was suggested by one breakout group, though there was some uncertainty about including this element. Experts confirmed that Pollution could be removed from the model structure, and suggested potential for removing or redefining the Forage Fishes and Rocky Reef elements. The argument made for hard habitats in the seafloor habitat model was also made for Rocky Reef, which provides habitat to Young-of-Year Fishes, specifically Essential Fish Habitat to rockfish, including yelloweye rockfish.

Multiple new links were suggested during Day 1. The positive link path from Subarctic Water Mass to Upwelling and then to Hypoxia was added, ending with a negative impact from Hypoxia on Benthic Invertebrates. The influence of Upwelling on Phytoplankton was removed to include the more mechanistic pathway of Upwelling having a positive effect on Nutrients, which then positively influenced Phytoplankton. The remaining suggested additional links are summarized below:

- Positive links
 - o From Upwelling to Ocean Acidification
 - o From Phytoplankton to Benthic Invertebrates
 - o From Rocky Reef to Young-of-Year Fishes
 - o From Kelp to Forage Fish
 - o From Nutrients to Kelp
 - o From Detritus & Bacteria to Hypoxia

- Reciprocal positive links between Phytoplankton and Detritus & Bacteria
- Negative links
 - From Ocean Acidification to Zooplankton
 - From Sedimentation to Rocky Reefs
 - From Commercial Fishing to Rocky Reefs
 - From Storms to Recreational Fishing
 - From Storms to Kelp
 - From Phytoplankton to Hypoxia
 - From Kelp to Hypoxia
 - From Hypoxia to Black Rockfish & Lingcod, Benthic Invertebrates, Sea Stars, and Urchins
 - From Sedimentation to Kelp, but at a lower relative impact than other impacts on Kelp

The resulting changes with preliminary scenario analyses were presented to workshop participants on Day 2 and can be seen in the diagram in Figure 3. The resulting discussion on Day 2 confirmed that Young-of-Year Fish and Forage Fish should not be condensed into a single element, and that there is no commercial fishing by fixed or bottom gears in kelp forest or Rocky Reef on the outer coast of Washington, nor is there fishing for Urchins in this system. Remaining topics discussed for the kelp forest habitat that need further evidence to complete the model are as follows:

1. The definition of the physical drivers for this model is different from the seafloor model, but this structure does reflect the correlation between Ocean Acidification and Hypoxia expected in this coastal system.
2. There was some debate on whether Kelp counteracts Ocean Acidification, particularly at more than a local scale. Work by Pfister et al. (2018, 2019) was suggested to help clarify these points.
3. Most effects of Ocean Acidification on calcareous invertebrates and Phytoplankton seemed reasonable, but confirmation was needed for effects on Urchins
4. An additional requested scenario attempted to model the trophic cascade resulting from addition or removal of Sea Otters and their effect on Urchins and Kelp, but the preliminary structure in Figure 3 did not reflect this. Shelton et al. (2018) was suggested as a resource showing that this classic dynamic is decoupled in recent years in offshore kelp forests.
5. Including salmon, at least in juvenile stages, was suggested in the surveys and discussion, with emphasis on the cultural importance of these habitats for salmon harvest by local tribes and the inclusion of these habitats as Essential Fish Habitat in federal management documents for these species. Multiple resources were provided, which appear in the Additional Resources section below.

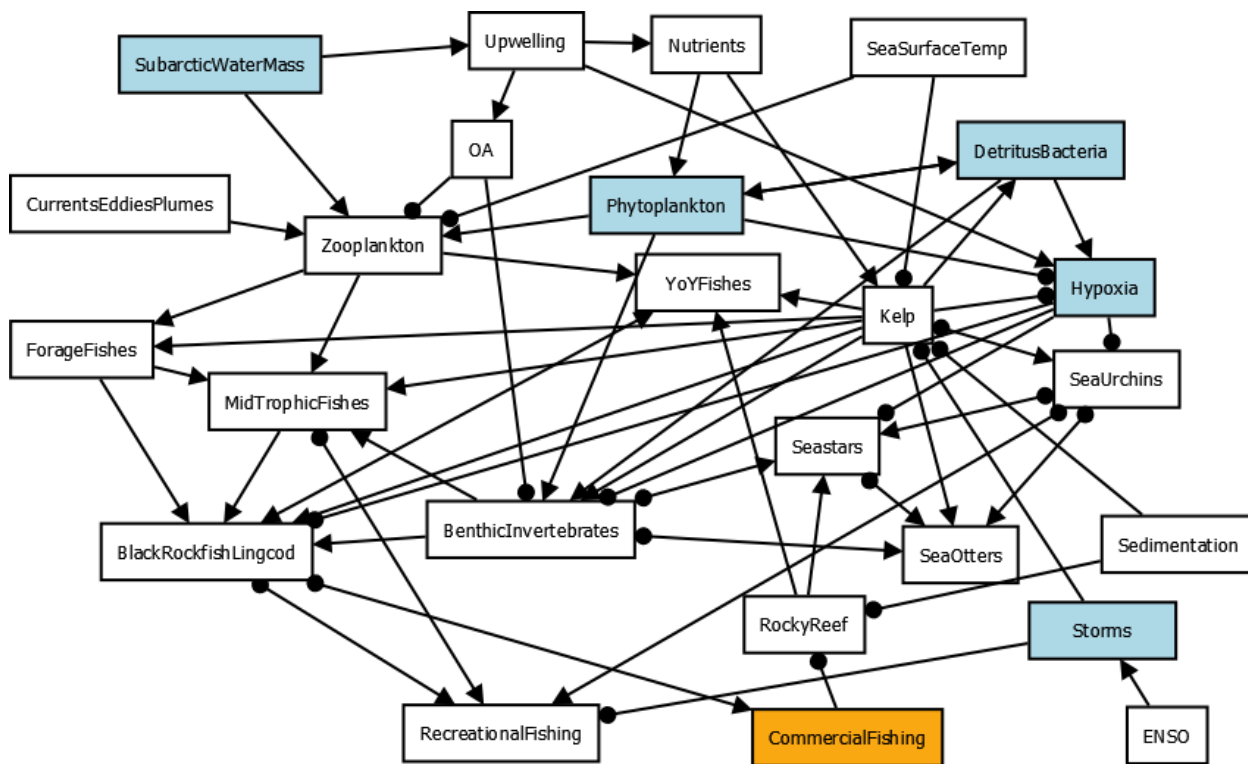


Figure 3: Edited kelp forest habitat network presented on Day 2 (Oct. 5th) of the workshop. Blue elements are elements redefined following breakout groups and yellow elements were added in breakout groups.

Remaining Tasks for Model Development

The models presented on Day 2 of the workshop are not the final versions that will be used for decision-making. Based on participant input outlined in the previous section and additional resources provided, Robert Wildermuth, with the help of collaborators, will finalize the model structures and present the draft models and analyses to the Washington Coastal Marine Advisory Group (WCMAC) and interested workshop participants. The remaining steps for the project are summarized below:

1. Finalize seafloor and kelp forest habitat model structures and element definitions, including full documentation of data sources and rationale based on workshop participant input.
 - a. This may include relevant aspects of human dimensions related to human wellbeing (see below).
2. Incorporate effects of likely new uses in these habitats, including offshore wind energy development, offshore aquaculture, and seafloor mining.
3. Evaluate which habitat elements of importance to management and human wellbeing are most sensitive to these new uses and changing climate conditions.
 - a. This includes identifying highly influential model elements in each system, highly uncertain yet important estimated pathways in the modeled systems, and whether indicator data exist to closely monitor these elements and relationships.
4. Report draft results to WCMAC and workshop participants.
5. If needed, revise models based on WCMAC and participant comments.
6. Hand-off final models and analyses in the form of a project report to Washington’s Department of Ecology.

- a. Time was provided to discuss ownership of the final model and possible future collaboration on Day 2 of the workshop, but this was not of interest to workshop participants. Model ownership must still be resolved.
7. Publish findings in a peer-reviewed scientific journal.

Potential New Ocean Uses for Consideration

As part of the workshop, we recorded potential new ocean uses mentioned by workshop participants in discussions and pre-meeting and exit surveys that may need to be considered in these models under the Washington Marine Spatial Plan. In addition to the uses identified by Washington's Department of Ecology (i.e., offshore renewable energy development, offshore aquaculture, and seafloor mining) workshop participants also identified vessel traffic as a use in kelp forest habitats. Although not a new ocean use in terms of resource extraction by a particular industry sector, one respondent to the surveys also posed the effects of habitat restoration as another activity in these habitats that may be evaluated with these models.

Human Dimensions of Note

Similar to potential new ocean uses, we also asked workshop participants about important socioeconomic or other human dimensions contributing to human wellbeing in the seafloor and kelp forest systems. These human dimensions, or potential interactions with the ecological system, mentioned during the workshop and in the surveys are noted below:

- Tribal treaty rights and Usual and Accustomed (U&A) fishing grounds
- Harvest of kelp
- Discards resulting in detritus
- The definition of Pollution in each model was not sufficient for including in these structures, but refining the types of pollution, and particularly allowing descriptions of oil spill impacts, may better reflect impacts on these habitats.
- Disturbance to seafloor structure-forming elements
- Interactions between salmon and Southern Resident orca populations were mentioned in the context of meeting management directives.

Finally, the work of Breslow et al. (2017) and Poe et al. (2014) were offered as resources on aspects of human wellbeing to include in our analyses.

Additional Resources

Meeting documents and model code can be made available upon request.

Websites:

- Northwest Straits Commission: <https://nwstraits.org/our-work/kelp/>
- NOAA's West Coast Habitat Conservation:
 - o <https://www.fisheries.noaa.gov/west-coast/habitat-conservation/kelp-forest-habitat-west-coast>
 - o <https://www.fisheries.noaa.gov/west-coast/habitat-conservation/habitat-areas-particular-concern-west-coast>
 - o <https://www.fisheries.noaa.gov/west-coast/habitat-conservation/essential-fish-habitat-west-coast>
- The Ocean Carbon and Biogeochemistry Project: <https://www.us-ocb.org/dominant-physical-mechanisms-driving-ecosystem-response-to-enso-in-the-california-current-system/>

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Miscellaneous:

Kelly Andrews also provided the workshop hosts with figures from the 2020 Olympic Coast National Marine Sanctuary's Condition Report detailing the amount of soft and hard seafloor habitats exposed to bottom trawl gear and a PowerPoint presentation by Sara Hamilton of Oregon State University about kelp population dynamics along the Oregon coast.

Project Glossary

Term	Definition	Reference
Seafloor Habitat	All bottom habitats below ~30 m depth in WAMSP waters	WA Ecosystem Indicator Report, Andrews, Coyle & Harvey, 2015
Kelp Forest Habitat	Habitats that consist of floating kelp canopies of bull kelp <i>Nereocystis leutkeana</i> or giant kelp <i>Macrocystis pyrifera</i> or rocky reefs that occur at depths <30 m within WAMSP waters	WA Ecosystem Indicator Report, Andrews, Coyle & Harvey, 2015
Model Element	Measurable states of system parts or variables that interact or depend on states of other variables in the system	Justus 2006, Dambacher et al. 2002
Link	A directional interaction between one model element or variable and another represented as a functional relationship with positive (increasing) or negative (decreasing) direct response on the dependent variable	Justus 2006
Component	A discrete segment of the ecosystem (biological, physical, or human-dimension related) that reflects societal goals or values and should be relevant to the policy goals of Washington State	WA Ecosystem Indicator Report, Andrews, Coyle & Harvey, 2015
Attribute	A characteristic of a component that defines the structure, composition, and function of the ecosystem that is of scientific or management importance but insufficiently specific or logistically challenging to measure directly	WA Ecosystem Indicator Report, Andrews, Coyle & Harvey, 2015
Indicator	A quantitative biological, chemical, physical, social, or economic measurement that serves as a proxy for the conditions of an attribute(s) of natural and socioeconomic systems	Landres et al. 1988, Kurtz et al. 2001, EPA 2008, Fleishman and Murphy 2009

Participant List

Participant	Affiliation	Role
Teresa Pucylowski	WA Dept. of Ecology	Host
Casey Dennehy	WA Dept. of Ecology	Host, Facilitator
Chris Harvey	Northwest Fisheries Science Center, NOAA	Host, Facilitator
P. Sean McDonald	University of Washington	Host, Facilitator
Gavin Fay	University of Massachusetts Dartmouth	Host, Facilitator
Robert Wildermuth	University of Massachusetts Dartmouth	Host
Amanda Hart	University of Massachusetts Dartmouth	Rapporteur
John Ryan-Henry	Coastal States Organization	Rapporteur
Mike Molnar	Coastal States Organization	Rapporteur
Rachel Keylon	Coastal States Organization	Rapporteur
Brittney Parker	Coastal States Organization	Rapporteur
Scott Mazzone	Quinault Indian Nation	Participant
Julie Ann Koehlinger	Hoh Tribe	Participant
Staci McMahan	University of Washington	Participant
Andy Lanier	West Coast Ocean Data Portal	Participant
Katie Wrubel	Olympic Coast National Marine Sanctuary	Participant
Waldo Lakefield	Oregon State University	Participant
Micah Horwith	WA Dept. of Ecology	Participant
Laura Koehn	NOAA West Coast Region Protected Resources	Participant
Kym Jacobsen	Northwest Fisheries Science Center, NOAA	Participant
Kelly Andrews	Northwest Fisheries Science Center, NOAA	Participant
Shallin Busch	Northwest Fisheries Science Center, NOAA	Participant
Corey Niles	WA Dept. of Fish and Wildlife	Participant
John Vavrinec	Pacific Northwest National Laboratory	Participant
Natalie Coleman	WA Dept. of Ecology	Participant
Whitney Roberts	WA Dept. of Fish and Wildlife	Participant
Rich Osborne	University of Washington	Participant
Abigail Harley	NOAA Fisheries	Participant
Tarang Khangaonkar	Pacific Northwest National Laboratory	Participant
Tommy Moore	Northwest Indian Fisheries Commission	Participant
Helen Berry	WA Dept. of Natural Resources	Participant
Marisa Nixon	West Coast Ocean Data Portal	Participant
Roxanne Carini	Northwest Association of Networked Ocean Observing Systems	Participant
Terrie Klinger	University of Washington	Participant
Samantha Siedlecki	University of Connecticut	Participant
Simone Alin	Pacific Marine Environmental Laboratory, NOAA	Participant
Genevra Harker-Klimes	Pacific Northwest National Laboratory	Participant
Elizabeth Clarke	Northwest Fisheries Science Center, NOAA	Participant
Jan Newton	University of Washington, Northwest Association of Networked Ocean Observing Systems	Participant

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² Washington Department of Ecology, 300 Desmond Drive SE, Lacey, WA 98503

³ Conservation Biology Division, Northwest Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 2725 Montlake Boulevard E., Seattle, WA 98112

⁴ Program on the Environment, School of Aquatic & Fishery Sciences, University of Washington, 3737 Brooklyn Ave NE, Seattle, WA 98105

Reference Materials Regarding Invasive Species

Washington Invasive Species Council Strategic Plan

The 2020-2025 Washington Invasive Species Council Strategic Plan provides priorities, direction, and formalizes the council's commitment to invasive species control and prevention.

[2020-2025 Washington Invasive Species Council Strategic Plan](#)

2020 Washington Invasive Species Council Biennial Report

This report summarizes key achievements in 2019-2020 and outlines its path forward to achieving even more.

[2020 Washington Invasive Species Council Biennial Report to the Legislature](#)

Economic Impact of Invasive Species Report

A 2017 report assessed the damages and potential impacts that could result if 23 of the state's known 200 invasive species were allowed to spread in Washington in a single year without prevention or control measures. The report aimed to help state agencies better understand the cost of invasive species lost in jobs, wages, and business sales.

In terms of lost revenue and jobs, the report found that the state would lose \$47.6 million in recreation, \$100.5 million in water facilities, \$282.9 million in livestock, \$297 million in timber, and \$589.2 million in crops.

[Economic Impact of Invasive Species to Washington State Fact Sheet](#)

[Economic Impact of Invasive Species Report](#)

Aquatic Invasive Species Funding Advisory Committee Report and Recommendations

In 2015, the state Legislature tasked the Washington Invasive Species Council with coordinating an advisory committee to develop recommendations for long-term funding to manage and prevent aquatic invasive species in Washington State. This report and its recommendations formed the basis for Senate Bill [5303-2017-18](#) and House Bill [1429-2017-18](#). This additional funding to the Washington Department of Fish and Wildlife Aquatic Invasive Species Unit is critical to the prevention and management of aquatic invasive species in Washington State.

[Aquatic Invasive Species Funding Advisory Committee Report and Recommendations](#)

WCMAC Coastal Resilience: March 2021 Updates

The Washington Coastal Marine Advisory Council's (WCMAC) is pursuing a Governor's request to identify high priority needs and actions to carry out the recommendations listed in the Ruckelshaus Center's "[Washington State Coast Resilience Assessment](#)" (Assessment). The Assessment describes two linked but distinct efforts to further these recommendations:

1. **Economic well-being** along Washington's outer coast is a critical aspect of community resilience. The WCMAC Economic Resilience Workgroup has held a series of webinars to support development of a collective future vision for economic resilience on the Washington coast to further the Assessment's recommendations.
2. **Coastal hazards resilience** is limited by significant capacity constraints at the local level. The Assessment recommends a "Coastal Hazards Organizational Resilience Team" (COHORT) to establish "a coast-wide resilience initiative to enhance and integrate efforts." The Resilience Action Demonstration project (RAD) piloted this concept by providing coordinated agency support to locally-led resilience projects and identifying opportunities to support coastal hazards resilience. RAD takeaways are now being brought to WCMAC for the first time.

The following sections describe key themes from these efforts, and propose next steps for WCMAC:

- Economic Resilience: WCMAC Economic Resilience Workgroup Webinars
- Coastal Hazards Resilience: Resilience Action Demonstration Project (RAD)
- Next Steps to Develop WCMAC Recommendations for Economic and Coastal Hazards Resilience

Economic Resilience: WCMAC Economic Resilience Workgroup Webinars

Background and Goals

Median incomes on the coast are low relative to many other parts of the State, unemployment rates are high, and natural resource dependent communities disproportionately impacted by changing environmental conditions. It is challenging for coastal communities and individuals to dedicate the necessary energy or investment into being proactive for the future when they are having a difficult time surviving in the present.

To date, WCMAC's Economic Resilience Workgroup has held a series of 4 webinars on: 1) the tourism industry, 2) the forest resources and industries, 3) the ocean and marine industries, and 4) economic resilience. The goal of these virtual webinars is to build towards a workshop that defines a collective future vision for economic resilience on the Washington coast and develop recommendations that will better equip communities to address this complex problem and advance alternative paths. The objectives are as follows:

- Create a **shared understanding** about economic resilience challenges on the Washington coast.
- Generate and compile a list of **projects in coastal communities** that support the vision for economic resilience and require funding, indicating those in opportunity zones.
- Identify potential **opportunities for supporting projects** (e.g., grant programs and other funding sources).
- Inform and shape **recommendations from WCMAC to the Governor's Office** for building economic resilience on the Washington coast and elevating the conversation statewide.

Economic Resilience Webinar Summaries

To date, there have been a series of 4 webinars on various industries and considerations for Washington's coastal communities and economies.

Tourism Industries Webinar — November 12, 2020

Speakers included:

- **Steve Shively**, Tourism Director for Jefferson County, Tourism Marketing Director for the Olympic Culinary Loop, and NOAA National Marine Sanctuary's Tourism Group
- **Diane Solem**, General Manager for Ocean Shores and Marketing Director
- **Andi Day**, Executive Director for Pacific County Bureau, President-elect of the Washington Tourism Alliance

Some key themes from the webinar included:

- Tourism is one of **the top industries** for many coastal counties and communities.
- There are many opportunities for **restorative or sustainable tourism**.
- There needs to be a shift in **how we measure success for tourism** – meaning that more visitors aren't always better. For example:
 - There is a stark difference in having 4,000 tourists spend \$100 each versus 400 tourists spending \$1,000 each.
 - When people consume Willapa oysters, want them to be lifelong consumers (not just for their stay).
- Economic sustainability and resilience will require **industries, community buy-in, and local political support**. Some opportunities include:
 - Leverage businesses to ensure that visitors also adopt a pro-environmental mindset (e.g., an environmental commitment welcome card in hotels).
 - Offer grants for cities and communities to improve marketing and outreach capacity.
 - Create a state-funded tourism marketing organization – WA is the only state not to have one.
 - Develop a network among communities to share opportunities and best practices for a cohesive coast-wide strategy.
- COVID-19 pandemic has provided an **opportunity to “reset” the tourism system** and make it work for the communities.

Forest Resources and Industries Webinar — December 10, 2020

Speakers included:

- **Brian Hatfield**, Forest Product Sector Lead of Washington Department of Commerce
- **Sándor Tóth**, Faculty member of UW's School of Environmental & Forest Sciences
- **Karen Affeld**, Director of North Olympic Development Council
- **Travis Joseph**, CEO of American Forest Resource Council
- **Matt Comisky**, American Forest Resource Council
- **Eric Delvin**, Director of Emerald Edge for The Nature Conservancy
- **Jill Silver**, Director of 10,000 Years Institute

Some key themes from the webinar included:

- There are **increasing opportunities for forestry** due to its **role in combating climate change**.
 - Cross-laminated timber, biochar, and other forest products are garnering increasing public and private-sector interest due to its **carbon storage and sequestration capabilities**.
 - There are **new carbon offset markets** that can incentivize sustainable forestry practices; however, these **carbon offset markets can be problematic**. Offset programs can become ineffective due to wildfires, verification issues, and loopholes.
- There is increasing interest in **forestry models that provide benefits to local communities** and other economic development opportunities.

- **Forest restoration supports forestry, recreation, agriculture, and fisheries.** Forest restoration can provide local economic growth and jobs, but it needs a **more stable funding source.**

Marine and Coastal Industries Webinar — January 14, 2021

Speakers included:

- **Joshua Berger**, Governor’s Maritime Sector Lead at the WA Department of Commerce
- **Molly Bold**, Business Manager at the Westport Marina and Port of Grays Harbor
- **Joe Schumacker**, Biologist at the Quinault Indian Nation
- **Laura Nelson**, PhD candidate at the UW School of Environment and Forest Sciences

Some key themes from the webinar included:

- There are a diversity of coastal jobs and maintaining this **diversity is essential** to coastal economic resilience.
- The **seafood industry and commercial fishing industry** provide stable jobs and make up the backbone of the marina. **Tourism or recreation can attract visitors**, but the jobs in these industries are typically more seasonal. According to a survey of coastal community viewpoints, **tourism was not ranked as a top threat to the fishing industry**, and there was minimal interest from those in the seafood and commercial fishing industry in transitioning to tourism or another natural resource-based job.
- Climate change impacts introduce **a lot of uncertainty** to fish management.
 - **New technologies** can model and estimate the impacts of climate change and vessels on fish stocks.
 - Commercial fisheries need to **diversify its fish stocks** to harvest what is available to them, but this may require more international cooperation on migratory fish stocks.
 - A majority of coastal community survey respondents said that they have a **hard time planning more than two years into the future.**
- There are opportunities to **build in redundancy** in the fish supply chain and market more directly to consumers.

Economic Resilience Webinar — February 11, 2021

Speakers included:

- **Kevin Decker**, Washington Sea Grant
- **Kerrie Hurd**, District Director, U.S. Small Business Administration
- **Chris LoBosco**, Civil Engineer and Interim WA Economic Development Region Contact
- **Don Albrecht**, Executive Director, Western Rural Development Center

Some key themes from the webinar included:

- Economic resilience is an area’s ability to **prevent, withstand, and quickly recover from major disruptions to its economic base.** A holistic view of economic resilience considers 7 areas that make up economic resilience: **financial, political, social, human, cultural, natural, and built.**
- **Automation has greatly impacted our economy.** Automation has increased productivity while wages have remained stagnant, and resource extractive industries that rural communities historically depended on need less workers than they used to. As a result, **diversification of rural economies helps support economic resilience.** Technology has made geographic distance less relevant, so there are promising opportunities for investing in remote work.
- Organizations like the **Small Business Administration, Economic Development Agency, and the Western Rural Development Center** can support coastal communities by providing **tools, mentorship, marketing support, funding, connections, and more.**

Coastal Hazards Resilience: Resilience Action Demonstration Project (RAD)

Background and Goals

The Resilience Action Demonstration project (RAD) is an 18-month (2020-2021) pilot effort to test coordinated multi-agency support for locally-led hazards resilience efforts, in furtherance of the Coastal Hazards Organizational Resilience Team (COHORT) or other forms of long-term support for Pacific coast resilience initiatives. The RAD is a NOAA-funded partnership between Washington Sea Grant and Washington State Department of Ecology. Takeaways from the RAD will be used by WCMAC to form recommendations to the Governor's Office.

In 2020, the RAD team conducted outreach to create an inventory of hazards priorities, hurdles and opportunities across the Pacific coast of Washington, including over 175 "on the shelf" projects that are ready for deployment as funding and opportunity arises. This outreach informed a framework of guiding principles and funding programs to support locally-driven hazards resilience projects through coordinated agency assistance. The RAD team next supported three locally-driven resilience projects to scope and submit funding requests:

- Port of Ilwaco and Port of Chinook: Baker Bay "Port to Port" Hazards Mitigation and Risk Assessment
- Willapa Erosion Control Action Now: North Willapa Shoreline Erosion Master Plan
- City of Ocean Shores: Oyhut Bay Erosion Analysis to Support Development of Mitigation Alternatives

Results from the Resilience Action Demonstration Project

Through outreach and resulting support for locally-led coastal hazards resilience projects, the RAD identified the following 15 draft takeaways, grouped by topic. Grounded in experiences to date (reports forthcoming), the RAD team is working with the Hazard Mitigation Working Group and Coastal Hazards Resilience Network to further inform strategies for coordinating agencies' hazards assistance to coastal communities. The resulting final takeaways will be discussed and refined into draft recommendations by the WCMAC Resilience Workgroup during April-May 2021 workshops.

Defining resilience in a coastal hazards context

1. Coastal hazards resilience projects ("projects") encompass **physical projects, community development efforts** (capacity building, strategy development, planning, etc.), and/or **educational activities**.
2. Coastal hazards mitigation **projects can be more resilient** by:
 - **addressing immediate needs in a way that is aligned with a long term vision** by incorporating place- and process-based design; past, present and future conditions; multiple hazards; adjacent or synergistic projects; and nature-based solutions.
 - **supporting local and system-wide benefits** through innovative approaches and sharing lessons learned, local capacity building activities, new partnerships spanning management regimes, and supporting additional community benefits (such as economic development, food sovereignty, or access to housing).
 - **actively engaging and collaborating with relevant parties**, including state and federal agencies, tribes, counties, cities, regional committees, under-represented groups, and/or private landowners.

Funding

3. **Funding opportunities are lacking for "community development" efforts, such as project scoping, capacity building, strategy development, and project planning activities**. Many flooding and erosion projects across the coast are at this stage of development.
4. **Grant requirements for matching funds** limit the ability of many coastal communities to receive funding.

5. Several communities are struggling to further tsunami mitigation projects that have nuanced hurdles related to engineering constraints, high costs, population density, public perceptions, and the legacy of past failures. **Creative funding approaches, public-private partnerships, focused and sustained outreach, or state/ federal support may be able to overcome these obstacles.**

Addressing local capacity limitations

6. Demand for projects outweighs supply of project champions: **community members and jurisdictional staff that can lead coastal hazards resilience efforts are essential yet stretched thin.** Jurisdiction staff often do not have time to manage larger projects and planning amidst near-term needs, even with the assistance of consultants.
7. **Support and collaboration from Washington State agencies can help local staff overcome capacity hurdles** to scope, outline, and submit competitive funding proposals for hazards resilience projects, or to better understand technical documents and grant language. In some cases, this is a minimal effort.
8. Hazards issues and processes may reach beyond jurisdictions' boundaries, but collaboration at an interjurisdictional scale is infrequent. Similarly, large-scale issues are often approached as multiple disconnected small projects rather than through holistic planning and resulting projects. **Scaling-up and connecting across synergistic efforts requires additional resources and capacity which many jurisdictions do not have.**

Furthering collaboration, partnerships, and coordinated agency assistance

9. **Strong support exists for additional projects similar to RAD and/or the formation of the COHORT** to align multi-agency resources and expertise, spearhead information sharing, enhance collaboration, and coordinate strategic investment and technical support for hazards resilience projects and programs. **Developing formal inter-agency coordination will take more time and effort** than the 18-month RAD project allows.
10. Projects often overlap WSDOT jurisdiction, and approximately 10% of the entire project inventory lists WSDOT as a possible partner agency. As such, **WSDOT could be considered as a potential COHORT state agency.**
11. **Additional coast-wide, regional, or local multi-disciplinary working groups to understand, coordinate, and advise adaptation to specific hazards** (e.g. a potential Pacific Coast Erosion Work Group, similar to EMD's Tsunami Work Groups or Willapa Erosion Control Action Now) would provide a forum for agencies and communities to share information and address hazard-related issues in a resilient manner. This could involve a dedicated team of agency permitting specialists who could facilitate multiple projects' permitting processes simultaneously and further a design-build approach to implementing coast-wide hazards resilience projects.

Supporting a pipeline of resilient projects

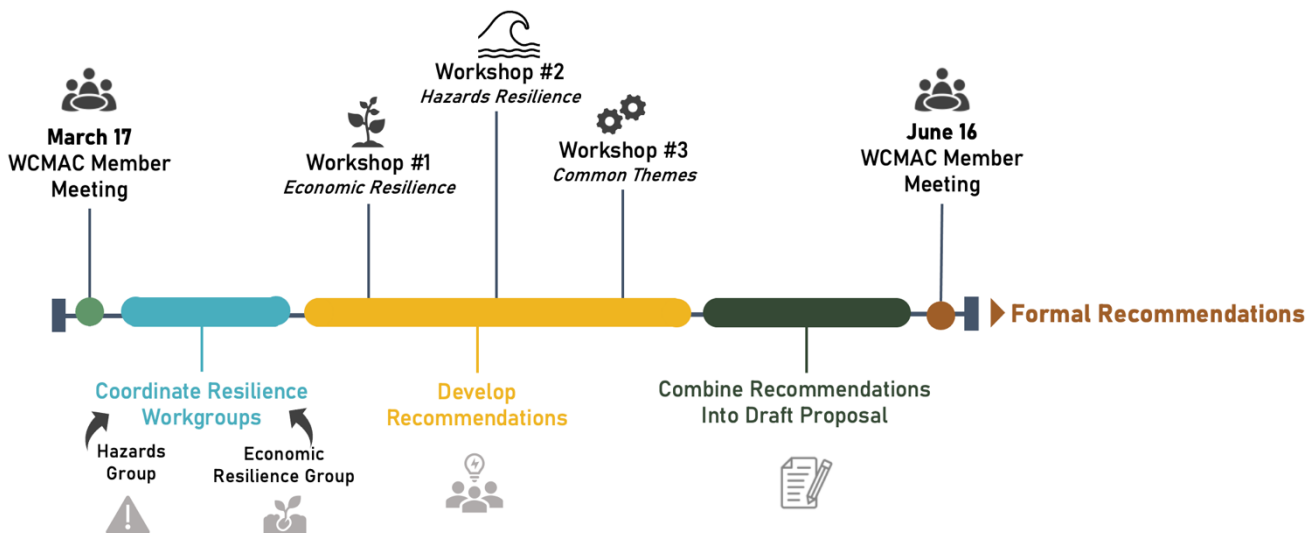
12. Many "on the shelf" projects were not described in local hazard mitigation plans, a key criteria for multiple funding opportunities. **More robust risk assessments and inclusion of these assessments' results (e.g. resulting projects) into Hazard Mitigation Plans** may provide greater likelihood of funding for resilient projects.
13. Flooding, erosion, and tsunami resilience projects were identified as priorities across the coast. These projects can often also encompass earthquake, landslide and sea level rise issues: **addressing specific hazards can provide opportunities for improved resilience against multiple other hazards.**
14. **Washington State Emergency Management Division's support was regularly cited as critical** to the advanced degree of tsunami mitigation projects. **Other hazards would benefit from similar focused agency attention.**
15. While education and outreach were mentioned as priorities, few projects that RAD identified were considering these activities. COHORT, Coastal Marine Resources Committees, or others could provide dedicated capacity to **connect local and regional hazards issues to educational programming.**

Next Steps to Develop WCMAC Recommendations for Economic and Coastal Hazards Resilience

Next Steps

The proposed next steps for both the RAD Coastal Hazards Team and the Economic Resilience Workgroup include:

- **March 17 WCMAC Member Meeting:** The coastal hazards resilience and economic resilience teams present updates and proposed timeline (below).
- **Coordinate Resilience Workgroup and Develop Recommendations:** The coastal hazards resilience and economic resilience teams merge into a WCMAC Resilience Workgroup to hold three workshops for WCMAC members:
 - **Workshop #1, Mid-April 2021:** Identify and refine potential economic resilience recommendations.
 - **Workshop #2, Late-April 2021:** Identify and refine potential coastal hazards resilience recommendations.
 - **Workshop #3, Mid-May 2021:** Identify common themes and opportunities to merge potential economic and coastal hazards resilience recommendations.
- **Combine Recommendations into Draft Proposal:** WCMAC Steering Committee reviews and refines potential recommendations and sends to WCMAC in mid-May.
- **June 16 WCMAC Member Meeting:** Present and discuss potential recommendations.
- **Formal Recommendations:** Adopt recommendations at the June WCMAC meeting or the following meeting (not yet scheduled).



Proposed Amendment to WCMAC Bylaws

Increasing the Maximum Size of the Steering Committee

Background

The current WCMAC bylaws call for a Steering Committee with between 2-4 at-large members as noted here:

III. Committees:

A. Committees will report to and advise the Council.

i) Steering Committee

a) The Steering Committee will be comprised of the Chair of the Council, Vice-Chair of the Council, the Governor's representative, and two to four members-at-large. The members at large will be nominated by the Steering Committee and confirmed by the Council. In nominating the members at large, the Steering Committee will consider balancing geographic and interest group representation on the Steering Committee.

Proposed Amendment:

The Chair and Vice-Chair of WCMAC would like to add another at-large member. The proposed amendment would amend the bylaws as follows:

III. Committees:

B. Committees will report to and advise the Council.

ii) Steering Committee

b) The Steering Committee will be comprised of the Chair of the Council, Vice-Chair of the Council, the Governor's representative, and two to ~~four~~ **five** members-at-large. The members at large will be nominated by the Steering Committee and confirmed by the Council. In nominating the members at large, the Steering Committee will consider balancing geographic and interest group representation on the Steering Committee.

Procedure

WCMAC will vote on the proposed amendment at the March 17, 2021 meeting. The current WCMAC bylaws allow for amendments using the following procedure:

1X. Amendments

These bylaws may be adopted and amended at any regular meeting upon a two-thirds vote of the Council, provided that the amendment has been submitted to all Council members in writing two weeks before the meeting.

DRAFT 2021-23 WCMAC Workplan

Draft 2/16/21

1. Topic: Coastal Resilience

- a. **Description:** Prioritize needs and actions to carry out the recommendations in the Ruckelshaus "Washington State Coast Resilience Assessment Final Report (2017)"
- b. **Background:** WCMAC action requested by Governor. Economic resilience workshops were added to this task, so that it now includes both coastal hazards and economic resilience.
- c. **WCMAC Focus/Purpose:** Information sharing, Informal advice, Formal recommendations to Governor/Legislature and others.
- d. **Timeframe:** 2021
- e. **Information Needs:**
- f. **Tasks:**
 - i. Guide Ecology and Washington Sea Grant in completing the "Washington Coast Resilience Action Demonstration (RAD) Project"
 - ii. Guide and participate in a series of science-policy workshops on coastal hazards
 - iii. Help shape recommendations to the Governor, the Legislature, and state and local agencies to further support long-term pre-disaster risk reduction for Washington's Pacific coast-wide resilience initiative.
- g. **Subcommittee Involvement (Technical Committee, other Working Group, etc.):** Sub-group has been meeting throughout 2020.
- h. **Meeting Agendas (if applicable):**
 - **Spring 2021:** Review output from workshops, begin to develop potential recommendations.
 - **Summer 2021:** Finalize Recommendations
 - **Fall 2021:** Continue work as needed.

2. Topic: Ecosystem Indicators

- a. **Description:** Provide feedback to the state on refining the list of ecosystem indicators.
- b. **Background:** WCMAC action requested by Governor. Contractor was hired to complete modeling work in early 2021.
- c. **WCMAC Focus/Purpose:** Informal advice.
- d. **Timeframe:** 2021
- e. **Information Needs:**
- f. **Tasks:**
 - i. Compile existing lists of indicators, summary of methods, and proposed process for refining indicators (WCMAC staff)
 - ii. WCMAC briefing and discussion (WCMAC Meeting)
 - iii. Staff and other experts participate in OCNMS Ecological Indicator selection process
- g. **Subcommittee Involvement (Technical Committee, other Working Group, etc.):** None recently.
- h. **Meeting Agendas (if applicable):**
 - **Spring 2021:** Presentation of work conducted by contractor.

- **Summer 2021:** Continue work if needed.
- **Fall 2021:** None anticipated.

3. Topic: Science and Research Agenda

- Description:** Provide feedback to the state on the development of a science and research agenda, including data gaps and WCMAC's priorities.
- Background:** WCMAC action requested by Governor
- WCMAC Focus/Purpose:** Information sharing, Informal advice.
- Timeframe:** 2021
- Information Needs:**
- Tasks:**
 - Compile Data Gaps (WCMAC Staff)
 - WCMAC Discussion on Initial List of Gaps and Priorities (WCMAC Meeting)
 - Coordinate with ecosystem indicators work.
- Subcommittee Involvement (Technical Committee, other Working Group, etc.):** None recently
- Meeting Agendas (if applicable):**
 - **Spring 2021:**
 - **Summer 2021:**
 - **Fall 2021:**

4. Topic: Monitor Implementation of Marine Spatial Plan (MSP)

- Description:** Keep WCMAC informed of and engaged in MSP implementation efforts
- Background:** WCMAC action requested by Governor
- WCMAC Focus/Purpose:** Information sharing, Informal advice.
- Timeframe:** 2021-23
- Information Needs:**
- Tasks:**
 - Summarize status of MSP implementation tasks (WCMAC staff)
 - Federal Consistency: Review Washington's authority in reviewing federal activities (completed in 2020)
- Subcommittee Involvement (Technical Committee, other Working Group, etc.):** None recently
- Meeting Agendas (if applicable):**
 - **Spring 2021:** Review output from workshops, begin to develop potential recommendations.
 - **Summer 2021:** Finalize Recommendations
 - **Fall 2021:** Continue work as needed.

5. Topic: WCMAC Administrative Tasks

- Description:** Adopt bi-annual workplan and elect chair/vice chair at the beginning of each biennium.
- Background:** See WCMAC by-laws
- WCMAC Focus/Purpose:**
- Timeframe:** 2021-23
- Information Needs:**
- Tasks:**

- i. Develop and approve workplan
 - ii. Elect officers/develop slate of Steering Committee members
 - iii. Steering Committee sets WCMAC agendas for each meeting and for work tasks between meetings.
- g. Subcommittee Involvement (Technical Committee, other Working Group, etc.):** Steering Committee
- h. Meeting Agendas (if applicable):**
- **Spring 2021:** Adopt 2021-23 Workplan and approve Steering Committee slate
 - **Summer 2021:**
 - **Fall 2021:**

2021-23 WCMAC Meeting Plan

Updated Monthly

March 17, 2021	
Topic	Presenter
• Offshore Aquaculture	▪ Dan Tonnes, NOAA
• Ecosystem Indicator modeling	▪ Robert Wildermuth, WCMAC Contractor
• Proposed Recommendations from Coastal Resilience Workshops (economic and coastal hazards) (if completed)	▪
• Approve 2021-23 Steering Committee Members	▪

June 16, 2021	
Topic	Presenter
• Update on N of Falcon	▪ WDFW (Ron Warren)
• Update on Erosion/Dynamic Revetment	▪ George Kaminski, ECY
• Discuss Proposed Coastal Resilience Recommendations	▪

Topics to weave into 2021-23 agendas:

- Discussion of data gaps/research needs
- Briefing on status of MSP implementation

For Reference

1. RCW 43.13.060—WCMAC Duties

- (1) The duties of the Washington coastal marine advisory council established in RCW [43.143.050](#) are to:
- (a) Serve as a forum for communication concerning coastal waters issues, including issues related to: Resource management; shellfish aquaculture; marine and coastal hazards; ocean energy; open ocean aquaculture; coastal waters research; education; and other coastal marine-related issues.
 - (b) Serve as a point of contact for, and collaborate with, the federal government, regional entities, and other state governments regarding coastal waters issues.
 - (c) Provide a forum to discuss coastal waters resource policy, planning, and management issues; provide either recommendations or modifications, or both, of principles, and, when appropriate, mediate disagreements.
 - (d) Serve as an interagency resource to respond to issues facing coastal communities and coastal waters resources in a collaborative manner.
 - (e) Identify and pursue public and private funding opportunities for the programs and activities of the council and for relevant programs and activities of member entities.
 - (f) Provide recommendations to the governor, the legislature, and state and local agencies on specific coastal waters resource management issues, including:
 - (i) Annual recommendations regarding coastal marine spatial planning expenditures and projects, including uses of the marine resources stewardship trust account created in RCW [43.372.070](#);
 - (ii) Principles and standards required for emerging new coastal uses;
 - (iii) Data gaps and opportunities for scientific research addressing coastal waters resource management issues;
 - (iv) Implementation of Washington's ocean action plan 2006;
 - (v) Development and implementation of coast-wide goals and strategies, including marine spatial planning; and
 - (vi) A coastal perspective regarding cross-boundary coastal issues.
- (2) In making recommendations under this section, the Washington coastal marine advisory council shall consider:
- (a) The principles and policies articulated in Washington's ocean action plan; and
 - (b) The protection and preservation of existing sustainable uses for current and future generations, including economic stakeholders reliant on marine waters to stabilize the vitality of the coastal economy.

2. Topics for Future Consideration

TOPIC	NOTES
Shipping overview	
Oil terminals	
Commercial Net Pen Aquaculture	
Offshore Aquaculture	
Shellfish Aquaculture Management Issues	E.g. Invasive species, burrowing shrimp, etc. Will provide ongoing updates to WCMAC as necessary.
Changing Fishing Fleets/Alternative Fishing Methods	
Coastal Energy	
Building Local Capacity	
Watershed Protection	
Ecosystem Services Valuation	
Ecology's Spill Program	
Ecological Indicators in Estuaries	

Sea Floor Mapping Update

Recreation and tourism issues

Ocean Acidification Sentinel Site

Nanoos Data

Nanoos presentation on new data products/apps for ocean users that help improve understanding of ocean conditions and safety (ideally Jan or Rachel)

Renewable Energy and Economics

Presentation by Brian Pogy of UW/PMECC and also a member of the science advisory panel. Could also speak to research happening in OR

3. Past Workplan Topics

Topics Addressed in Previous Meetings	Notes/Comments
Vessel Traffic/Navigational Safety/Transport of hazardous substances	Briefing on Grays Harbor Vessel Traffic Risk Assessment occurred at 3/28/18 meeting.
Ocean Acidification	Presentation by MRAC members at 6/13/18 meeting
Tsunami/Disaster Preparedness	Presentation at 6/13/18 Meeting
Juvenile salmon survey results and ocean conditions	Webinar in 9/18
Briefing from WDFW on recreation and commercial fishing allocation	Presentation at 12/12/18 meeting
Salmon Management	Workshop at 10/2/19 meeting
Potash Terminal in Grays Harbor	Presentation at 12/11/19 meeting
Harmful Algal Blooms (HAB)	Presentation at 4/1/20 meeting
Federal Consistency	Presented in Sept. 2020
Trends in changing ocean conditions	Presented in Sept. 2020



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Executive Order 13921 and Aquaculture Opportunity Areas



3-17-2021. Dan Tonnes, NMFS West Coast Region

Executive Order on Promoting American Seafood Competitiveness and Economic Growth

Executive Order focuses on:

- Regulatory reform to related to commercial fishing
- The expansion of sustainable U.S. seafood production through more efficient and transparent aquaculture permitting,



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E.O. Section 7: Aquaculture Opportunity Areas (AOAs)

- The Secretary of Commerce, in consultation with other appropriate Federal officials, appropriate Regional Fishery Management Councils, and in coordination with appropriate State and tribal governments, shall:
 - Within 1 year of date of E.O., identify at least two geographic areas containing locations suitable for commercial aquaculture.
 - Within 2 years of identifying each geographic area, complete a PEIS for each to assess the impact of siting aquaculture facilities there.
 - Each of following 4 years, identify two more geographic areas and complete PEIS within 2 years.



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How will we identify AOAAs?

We will use a combination of:

- National Centers for Coastal Ocean Science (NCCOS) siting analysis results & mapping tools
- Stakeholder input (Councils, Commissions, public)
- Interagency coordination





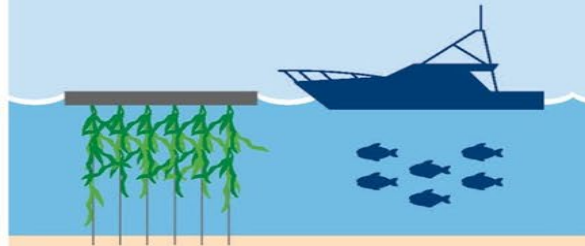
What is an Aquaculture Opportunity Area?

Aquaculture Opportunity Areas show high potential for commercial aquaculture. A science and community-based approach to identifying these areas helps minimize interference with other enterprises, account for current fishing patterns, and protect the ecosystem.

AOAs will expand economic opportunities in coastal and rural areas, and increase our nation's seafood security.

AOAs use the best available science to find appropriate spaces for sustainable aquaculture.

AOAs minimize interactions with other users, such as shipping, fishing, and the military.



Assessment and Use of AOAs

Stakeholder input is essential in the design and location of AOAs and NOAA expects these areas will be shaped through a public process that allows constituents to share their community and stewardship goals, as well as critical insights.

AOA size, exact location, and farm types will be determined through spatial analysis and public input to expand sustainable domestic seafood production while minimizing potential user conflicts. Farms will still need to go through the permitting process and environmental reviews.



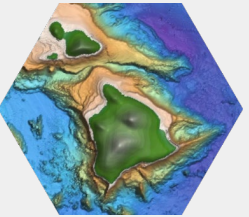
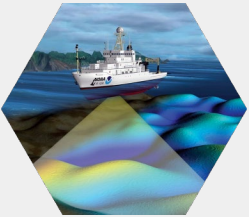
Permitting Still Required for AOAs

- The federal and state permitting and authorization requirements are the same within AOAs as anywhere else.
 - Aquaculture operations proposed within an AOA would be required to comply with all applicable federal and state laws and regulations (e.g., Clean Water Act, Rivers and Harbors Act, Endangered Species Act [ESA], essential fish habitat under the Magnuson-Stevens Act, Marine Mammal Protection Act).
- Potential impacts to protected species and habitats will be considered at multiple points in the process.
- Identifying AOAs is an opportunity for proactive stewardship to use best available global science-based guidance on sustainable aquaculture management, and support the “triple bottom line” of environmental, economic, and social sustainability.



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Opportunity Areas in Federal Waters



James Morris, Ken Riley, and team members

NOAA/NOS/NCCOS/Marine Spatial Ecology Division

james.morris@noaa.gov; ken.riley@noaa.gov



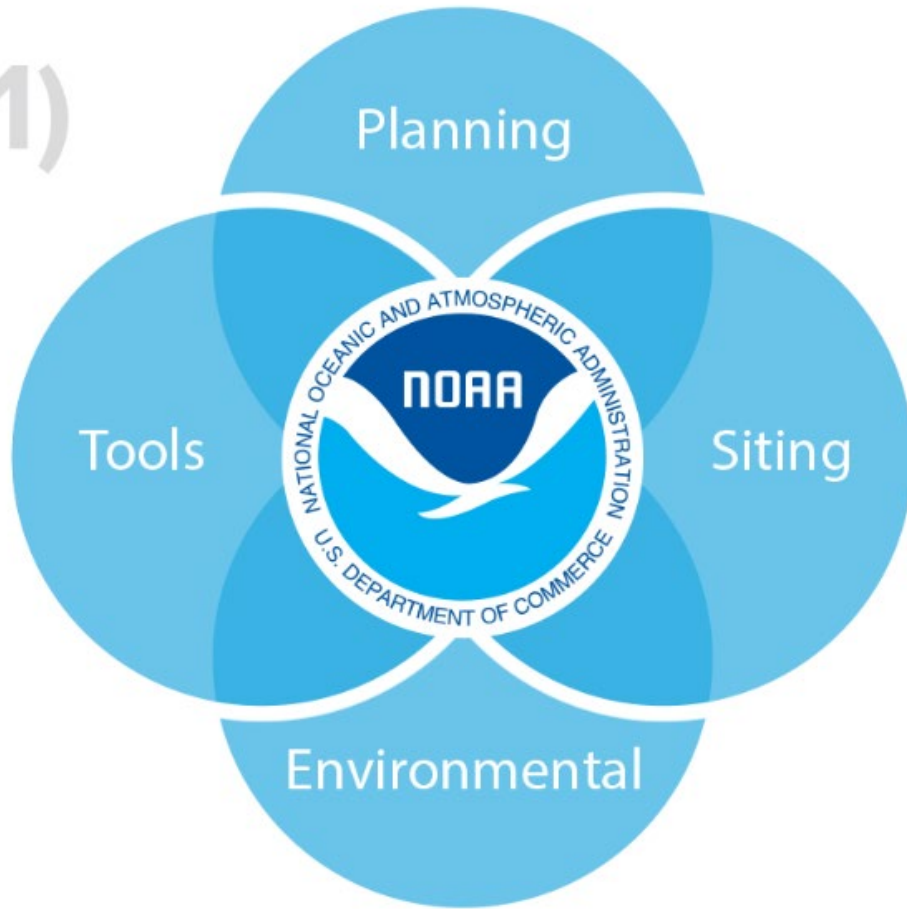
SCIENCE SERVING COASTAL COMMUNITIES



NOAA FISHERIES

The NOS AquaPortfolio

1)

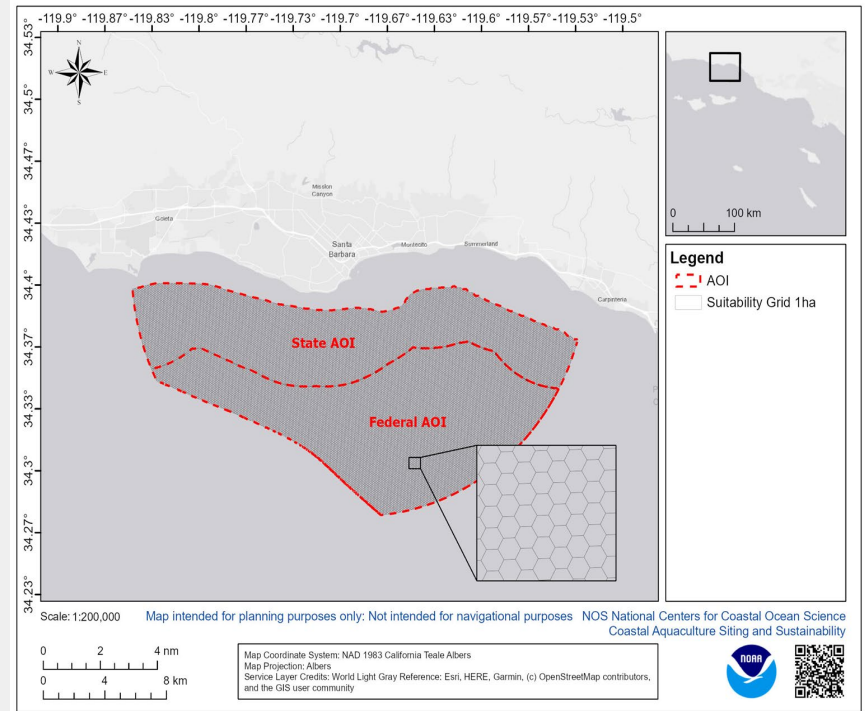
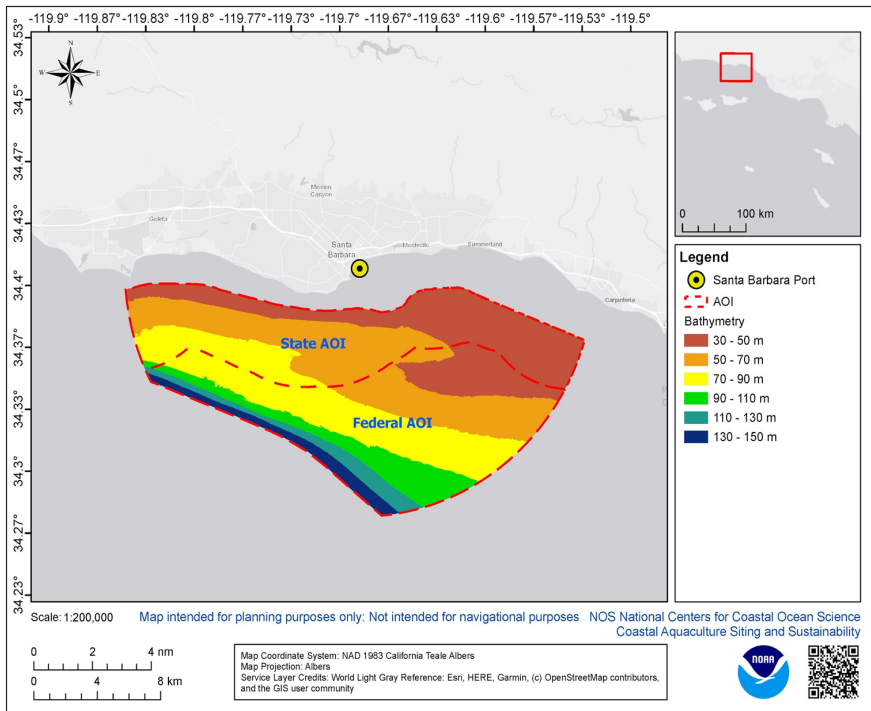


Spatial Planning for Aquaculture Opportunity Areas: Step 1 - What are the project requirements?

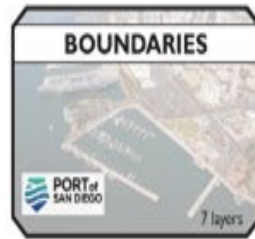
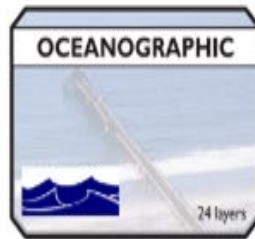


Requirement	
Preferred port	Santa Barbara
Federal/State waters	Federal or State Waters
Selected culture species	Giant Kelp (<i>Macrocystis pyrifera</i>)
Farm Footprint Size	133 acres (~54 ha)*
Maximum distance from port	≤ 8 nm
Gear depth requirements	≥ 30 and ≤ 150 m
Seawater temperature	< 20 °C
Current Velocity	< 1.02 m/s
Significant wave height	< 4 m

Step 2 - Map where aquaculture may be possible



Step 3 - Compile comprehensive geodatabase



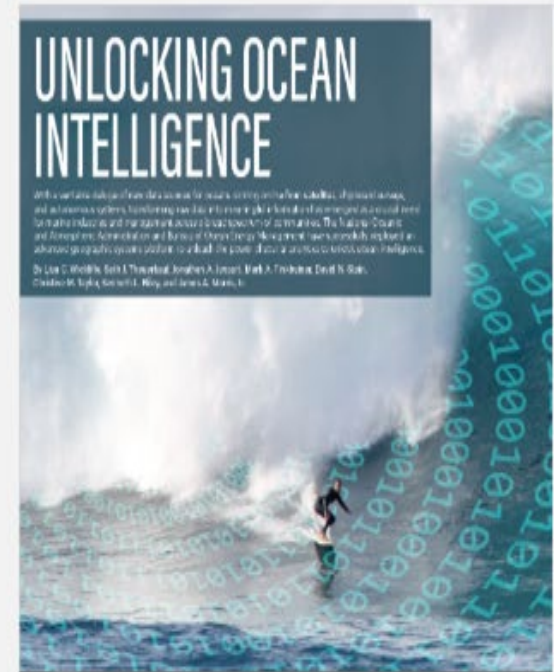
*Photos courtesy of the Port of San Diego



**AquaData
Catalog**

33 million

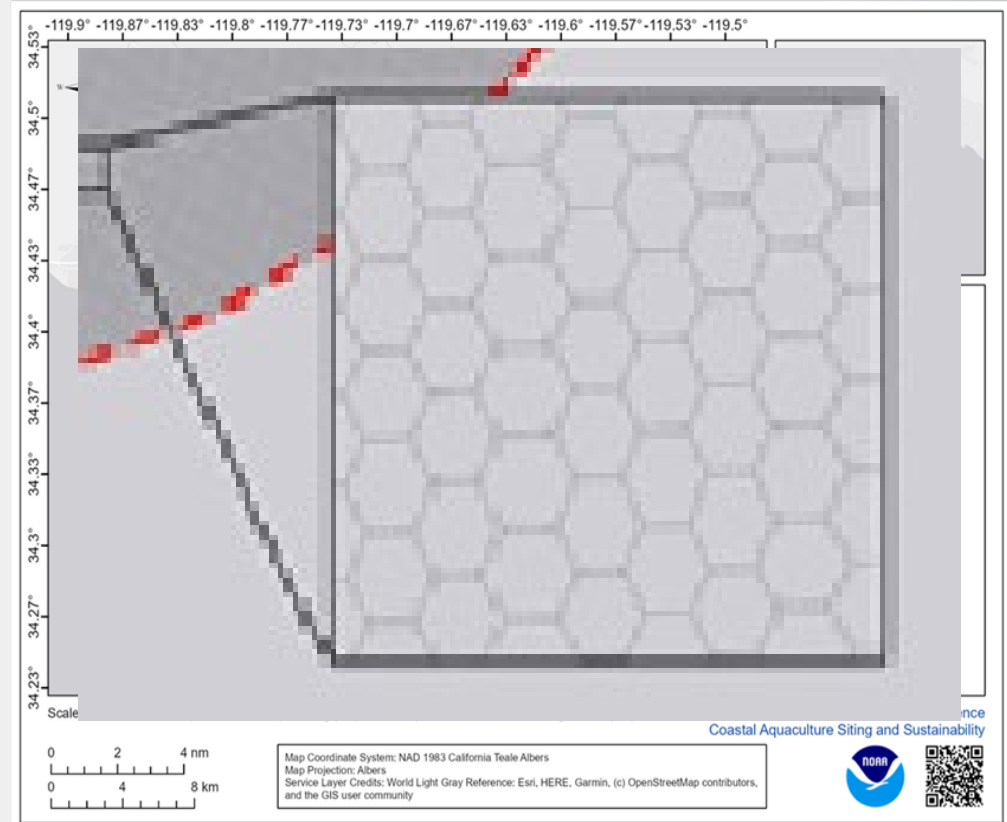
The number of data
layers we analyze to
find the right space
for your ocean
industry



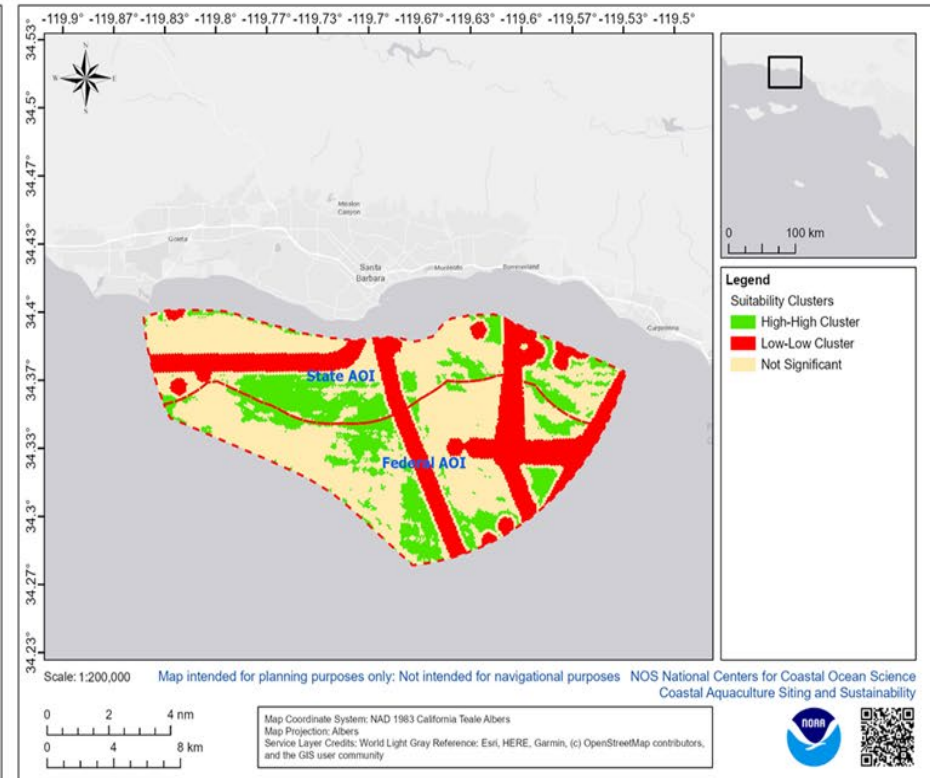
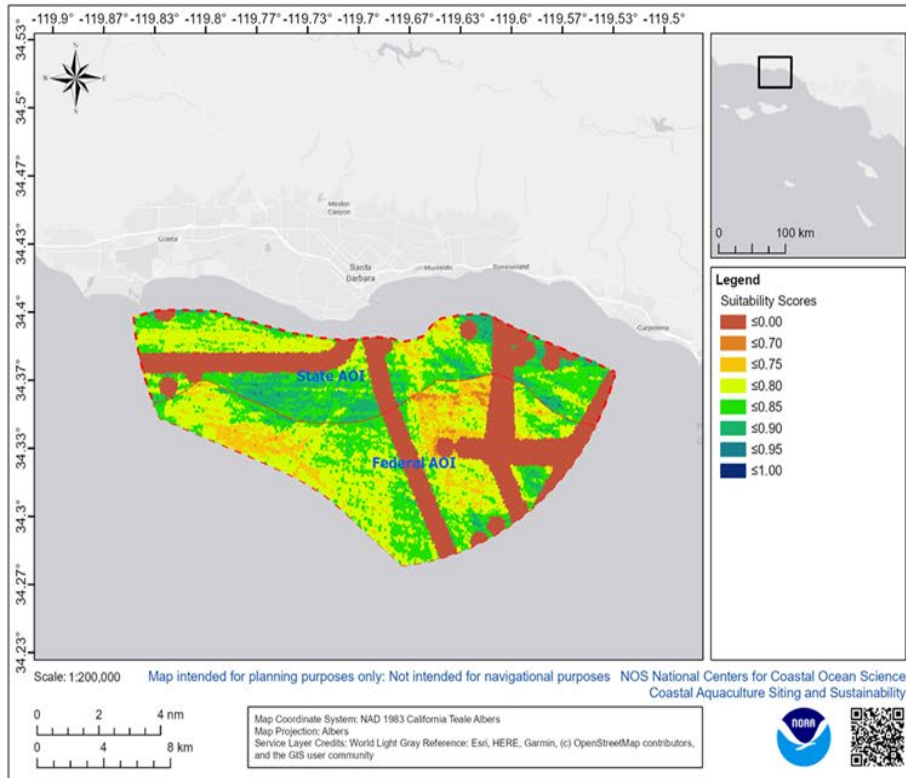
**NOAA
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Step 4 - Build a suitability model

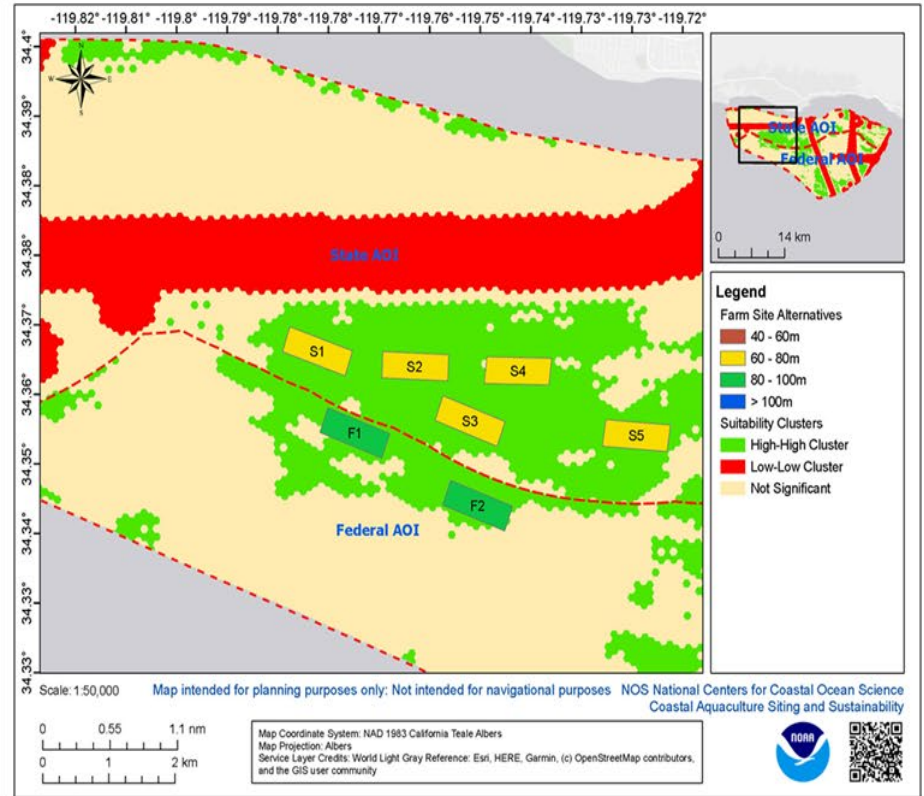
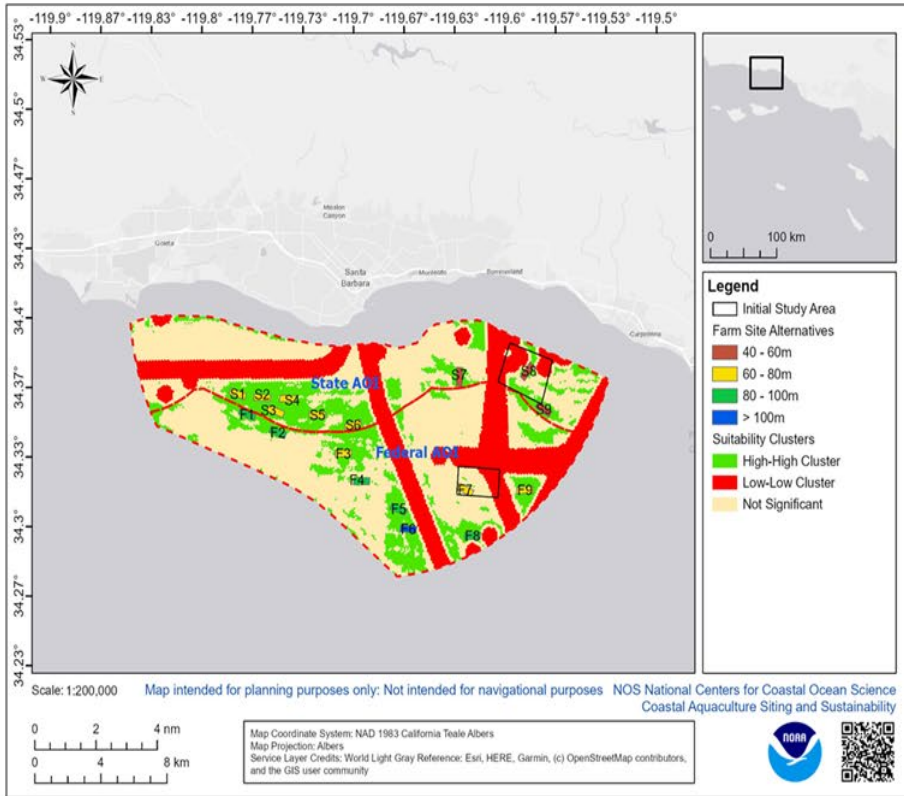
Data Layer	Cell score
Danger and Restricted Zones	0.5
Deep Sea Corals (200 m buffer)	0.5
Habitat Area of Particular Concern	0.5
Halibut Trawl Ground	0.5
Hard Bottom Habitat	0
Marine Protected Areas & Preserves	0.5
Offshore Oil and Gas Leases	0.5
Oil and Gas Pipelines (500 m buffer)	0
Oil and Gas Wells (500 m buffer)	0
Shipwrecks & Obstructions (500 m buffer)	0
Squid Landings by Micro-block	0.5
Submarine Cables (500 m buffer)	0
Unexploded Ordnance FUDS**	0.5
Wastewater Treatment Discharge (500 m buffer)	0



Step 5 - Cluster areas with highest suitability

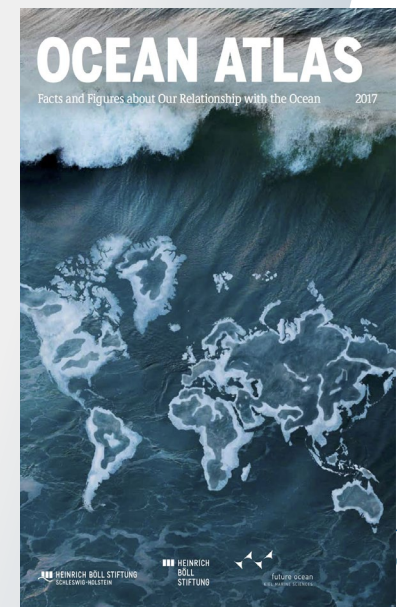
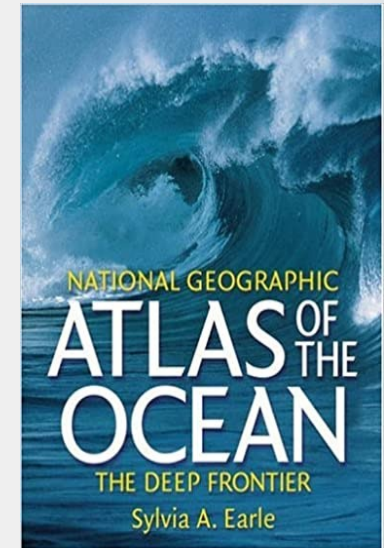


Step 6 - Identify best possible alternative locations



Step 7 & 8 - Characterize alternative locations & Develop report/atlas

AQUACULTURE OPPORTUNITIES IN SAN DIEGO BAY



Down the road...

- Social science & economic expertise within the AOA process.
- Keep an eye out for additional calls for input.



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FISHERIES

Questions?



dan.tonnes@noaa.gov

<https://www.fisheries.noaa.gov/insight/aquaculture-opportunity-areas>



NOAA
FISHERIES



WASHINGTON STATE
RECREATION AND CONSERVATION OFFICE

Washington Invasive
Species Council



Introduction to the Washington Invasive Species Council



What is an invasive species?

Washington State (Revised Code of Washington 79A.25.310)

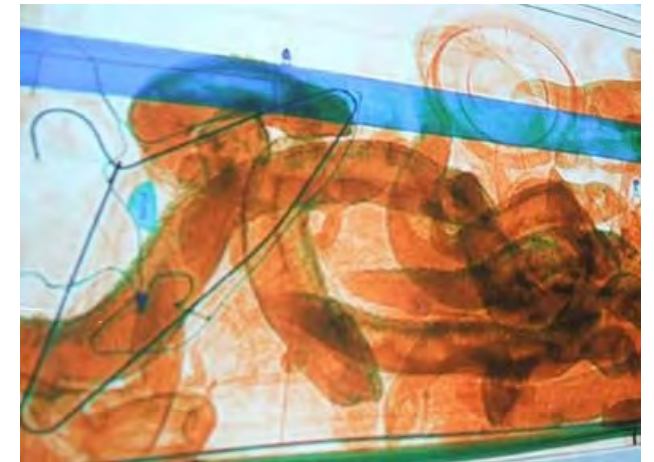
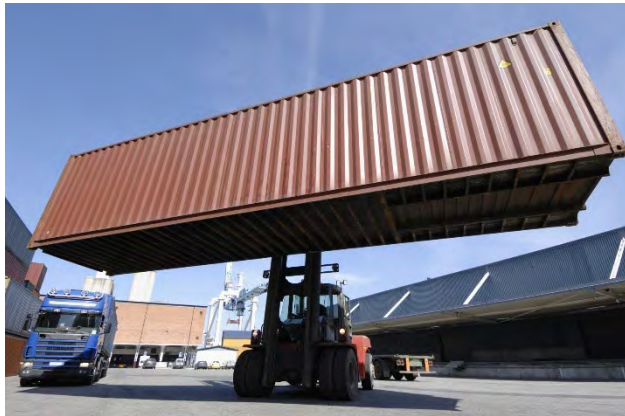
“Invasive species” include nonnative organisms that cause economic or environmental harm and are capable of spreading to new areas of the state. Does not include livestock, intentionally planted agronomic crops, or non-harmful exotic organisms

Examples include:

- **Plants**
- **Reptiles**
- **Amphibians**
- **Crustaceans**
- **Diseases**
- **Insects**
- **Mollusks**
- **Birds**



Pathways



Impacts



Organizations and Roles

Scales



Global

National

Regional

State

Local

Neighborhood

What is the council?

Established by the Legislature in 2006, extended in 2011, and 2016. Currently the council exists until June 30, 2022.

Vision

Sustain Washington's human, plant, and animal communities and our thriving economy by preventing the introduction and spread of harmful invasive species.

Mission

The council provides policy level direction, planning, and coordination that will:

- Empower those engaged in the prevention, detection, and eradication of invasive species.
- Include a strategic plan designed to build upon local, state, and regional efforts, while serving as a forum for invasive species education and communication.



Council Members

Joseph Maroney, Chair
Kalispel Tribe of Indians

Blain Reeves, Vice Chair
Washington State Department of Natural Resources

Trade Supervisor and Operations Manager
U.S. Customs & Border Protection

Steven Burke
King County

Clinton Campbell
United States Department of Agriculture

Pat DeHaan
United States Fish and Wildlife Service

Kendall Farley
Northwest Power and Conservation Council

Mary Fee
Washington State Noxious Weed Control Board

Adam Fyall
Benton County

Todd Hass
Puget Sound Partnership

Heidi McMaster
United States Department of the Interior

Vacant
United States Coast Guard

Todd Murray
Washington State University

Allen Pleus
Washington Department of Fish & Wildlife

Karen Ripley
United States Forest Service

Shaun Seaman
Chelan County Public Utility District

Lizbeth Seebacher
Washington State Department of Ecology

Ian Sinks
Columbia Land Trust

Pat Stevenson
Stillaguamish Tribe of Indians

Andrea Thrope
Washington State Parks and Recreation Commission

Brad White
Washington State Department of Agriculture

Advisory Panel and Support Staff

Industry Advisory Panel

Shaun Seaman, Council Panel Representative
Chelan County Public Utility District

Diane Cooper
Taylor Shellfish

Heather Hanson
Washington Friends of Farms and Forestry

Peter Schrappen
Northwest Marine Trade Association

Doug Levy
Recreational Boating Association of Washington

Mike Schwisow
Washington State Water Resources Association

Recreation & Conservation Office Staff

Justin Bush
Executive Coordinator

Alexis Haifley
Community Outreach and Education Specialist

Wyatt Lundquist
Board Liaison

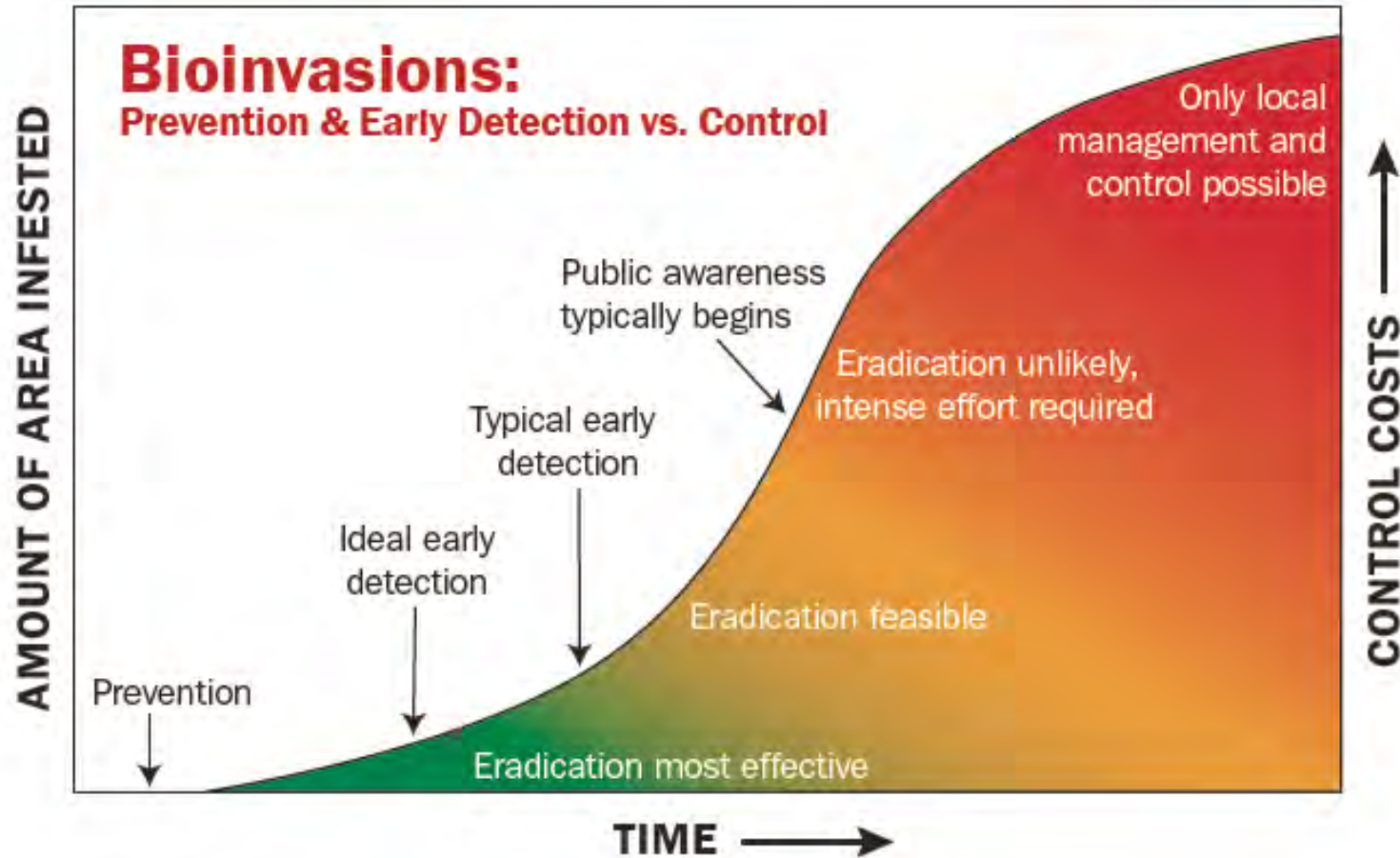
Julia McNamara
Administrative Assistant

RCO is an exemplary grant management agency that provides leadership on vital natural resource, outdoor recreation, and salmon recovery issues.

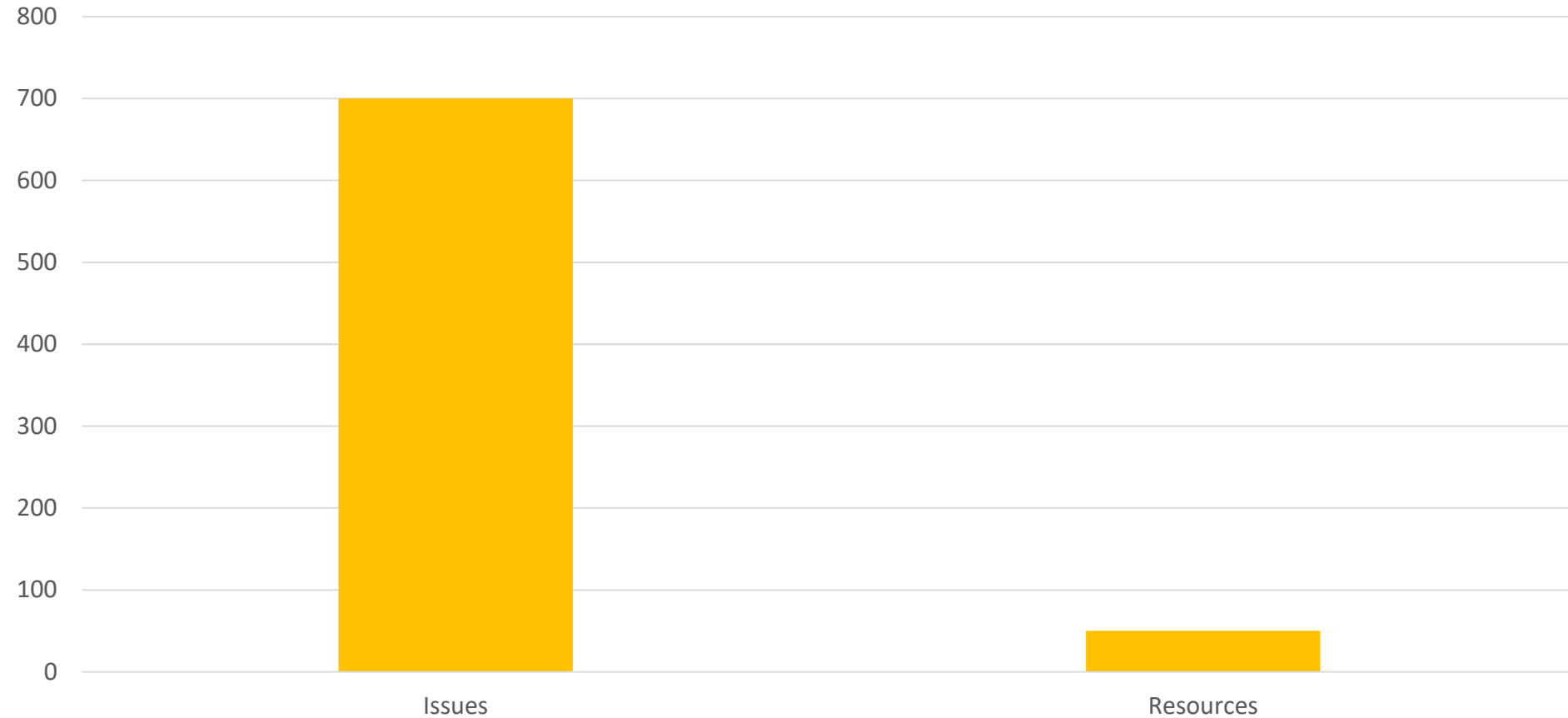
www.rco.wa.gov



PRIORITY PESTS AND THE PRIORITIZATION PROCESS



PRIORITY PESTS AND THE PRIORITIZATION PROCESS



PRIORITY PESTS AND THE PRIORITIZATION PROCESS

Proximity: Here, Near, Far

Summary of Scores:

Impacts

Ecological

Economic

Human Health

Ability to Prevent/Manage

Invasive Potential

Difficulty of Control

Feasibility of Prevention/Early Action

Washington Invasive Species Council
Invasive Species Impact Analysis
March 11, 2009

Impact Summary

Species/Guild Name: <i>Z/Q</i>	Impact Rating High Medium Low	Through the Gate? Here <u>Near</u> Far
-----------------------------------	----------------------------------	---

Is it Through the Gate? *location only impact*

Est. blvd species est. pop in

Here Species is having detrimental impacts in Washington. *est. pop*

Near Species is having detrimental impacts in Pacific Northwest region and similar habitat exists in Washington. *est. pop*

Far Impacts are seen in areas outside of the Pacific Northwest, including other countries, with climate conditions similar to Washington.

Summary of Scores

Ecological Impact	30
Economic Impact	30
Human Health Impact	3
Entry, Dispersal, Establishment, and Spread Potential	21 62
Distribution	0
Difficulty to Control	10 44
Other Species in Genus Invasive	3 42
Regulatory Controls in Place	10 109
TOTAL	107

Species are entering state along pathways no est. pop.

Worksheet *pick level that best describes category*

Points	Category	
1. <u>10</u>	ECOLOGICAL IMPACT	
	Impact on ecosystem processes.	
	A. No impact on ecosystem processes.	0
	B. Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability).	3
	C. Causes significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coasts, reduces areas of open water, alters water chemistry, alters rate of water retention, reduces ecosystem productivity).	6
	<input checked="" type="checkbox"/> D. Causes major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., alters geomorphology, hydrology, or fire frequency; fixes substantial levels of nitrogen in the soil which favors non-native species).	10
	U. Unknown	

PRIORITY PESTS AND THE PRIORITIZATION PROCESS

Here

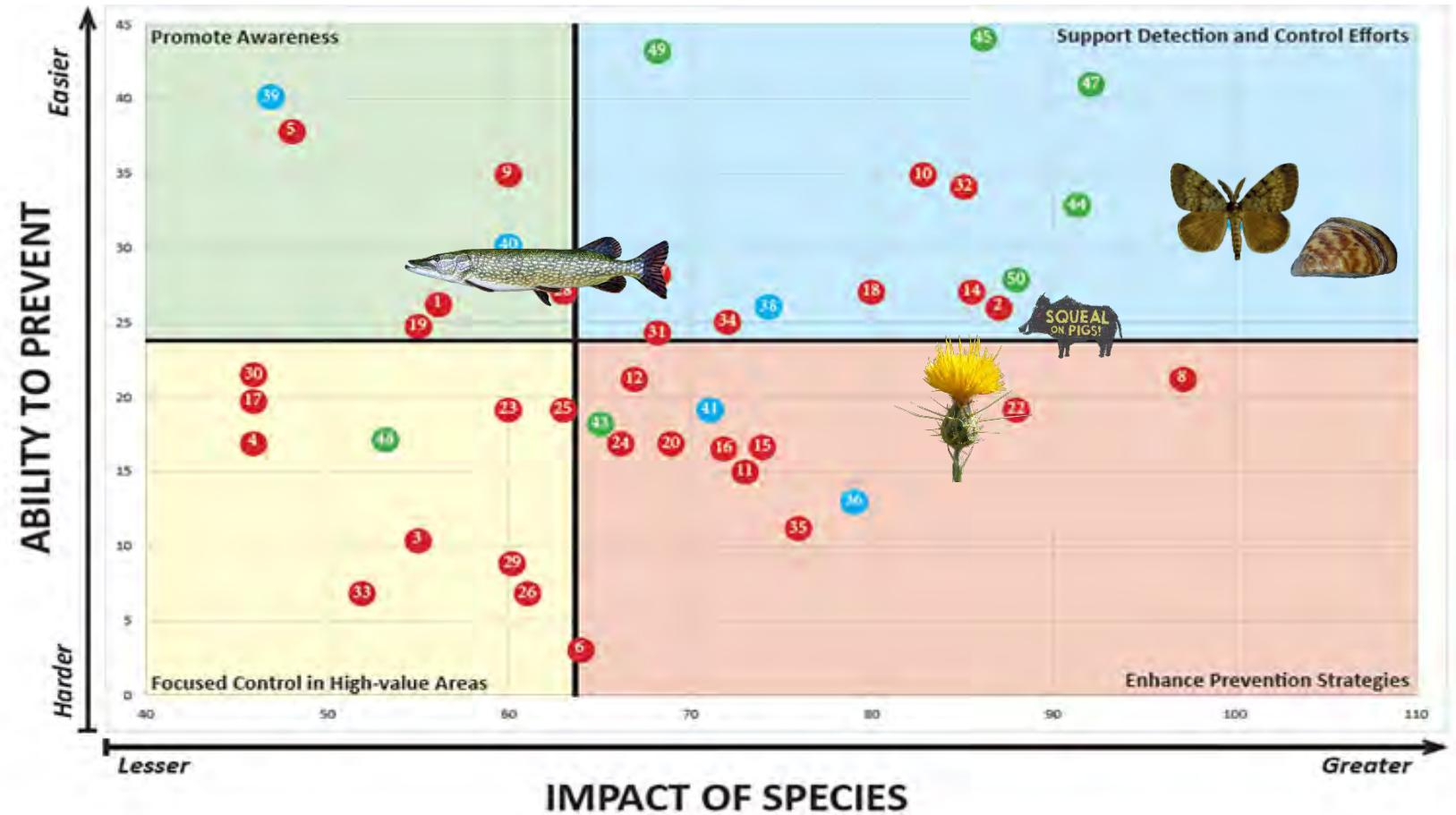
- Apple maggot
- Brazilian elodea
- Brown marmorated stink bug
- Butterfly bush
- Common crupina
- European chafer
- Feral swine
- Flowering rush
- Garlic mustard
- Hydrilla
- Infectious amphibian diseases
- Invasive frogs and crayfish
- Invasive knapweeds
- Invasive knotweeds
- Invasive milfoils
- Invasive tunicates
- Invasive zooplankton
- Leafy spurge
- Mediterranean white snail
- New Zealand mud snail
- Northern pike
- Nutria
- Parrotfeather
- Phragmites
- Poison hemlock
- Puncturevine
- Purple loosestife
- Rush skeletonweed
- Scarlet lily beetle
- Scotch broom
- Scotch thistle
- Spartina
- Spotted wing drosophila
- Tamarisk
- White nose syndrome/Pd

Near

- Caulerpa
- Gypsy moths
- Invasive crabs
- Japanese beetle
- Northern snakehead
- Overbite clam
- Zebra and quagga mussels

Far

- Asian carp
- Emerald ash borer
- Infectious fish diseases
- Invasive longhorned beetles
- Kudzu
- Onion leaf miner
- Sirex woodwasp
- Starry stonewort



Yellow Starthistle



Northern Pike



Gypsy Moths



Feral Swine



Zebra/Quagga Mussels

Strategic Plan



Plan Elements

- **Leadership & Coordination**
- Innovation and Research
- Education & Outreach
- Prevention
- Early Detection & Rapid Response
- Eradication, Control, and Containment

Strategic Plan: Leadership and Coordination

Key Priorities

- Statewide leadership and information sharing
- Coordination and response structures and processes
- State and federal policies and programming
- Sovereign nations and municipalities
- Unified industry and government



Strategic Plan



Plan Elements

- Leadership & Coordination
- Innovation and Research
- Education & Outreach
- Prevention
- Early Detection & Rapid Response
- Eradication, Control, and Containment

Strategic Plan: Innovation and Research

Key Priorities

- Understanding and evaluating impacts and invasion pathways
- Resilient landscapes and climate change
- Vulnerable species, resources, and infrastructure
- Diversity, inclusion, equity, and social justice



Strategic Plan



Plan Elements

- Leadership & Coordination
- Innovation and Research
- **Education & Outreach**
- Prevention
- Early Detection & Rapid Response
- Eradication, Control, and Containment

Strategic Plan: Education and Outreach

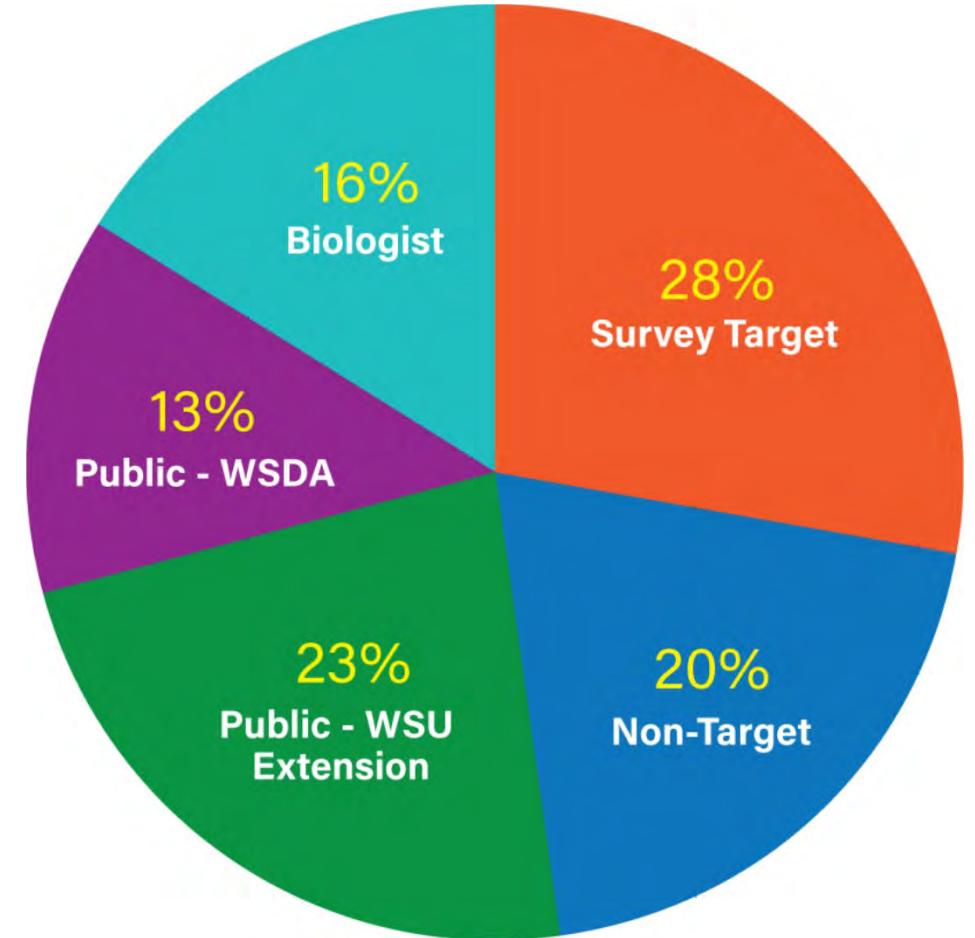
Key Priorities

- Public awareness and mobilization
- Policy maker awareness
- Youth and adult citizen science
- Professional development and cross-training
- Formal and information education



Strategic Plan: Education and Outreach

- Oregon Department of Agriculture documented 66 new introductions since 2007 (LaBonte 2014)
- Washington State Department of Agriculture documented 70 new introductions since 1991 (Looney et al 2017)



Strategic Plan: Education and Outreach



Washington Pest Watch

A “new” network led by the Washington Invasive Species Council and partners with the goal of harmonizing messaging, resources, and reporting pathways between existing programs.

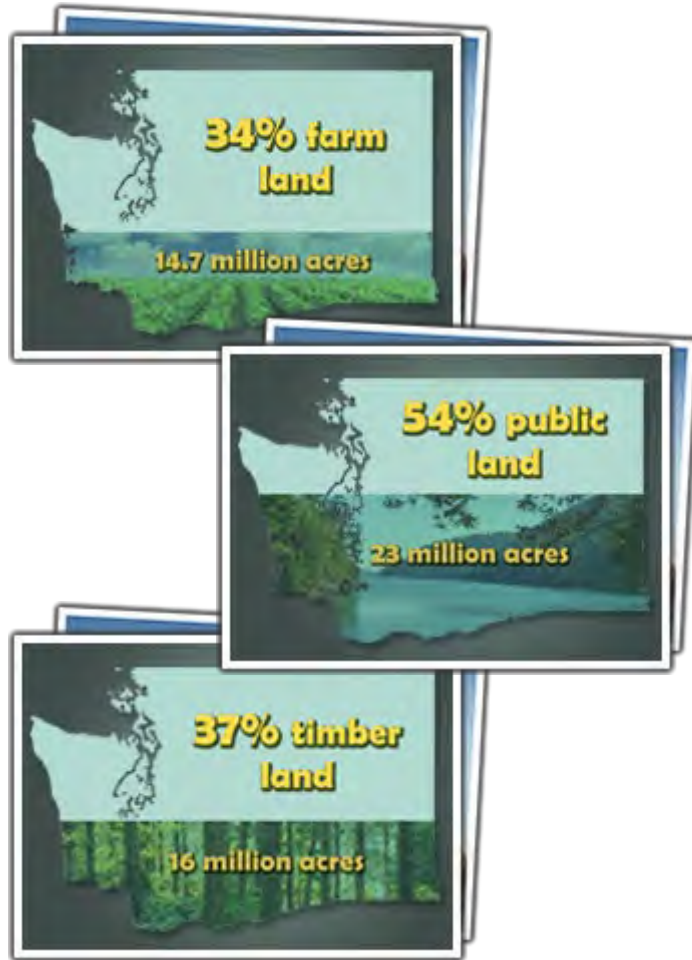
Goal

- NOT to actively search for invasive species

- IS to passively integrate detection and reporting into daily life (hiking, boating, biking, etc.)

Attend a training – See something? Say something!

Strategic Plan: Education and Outreach



Do you enjoy and appreciate Washington's outdoors?

Are you a hiker, hunter, or sport fisher?

Do you take your family to our [State Parks](#), [National Parks](#), [National Forests](#), [State Forests](#), or other public spaces to picnic, camp, or boat?

Do you or does someone you know have trees in your yard, have a garden, or farm?

If the answer to any of these questions is yes, you have a great reason to become a first detector.

We know how to stop invasive species, but we need your help. Everyone has a role to play in invasive species prevention and management.

Strategic Plan: Education and Outreach

Trainings

In-person trainings

WSU or partner led

On-demand trainings

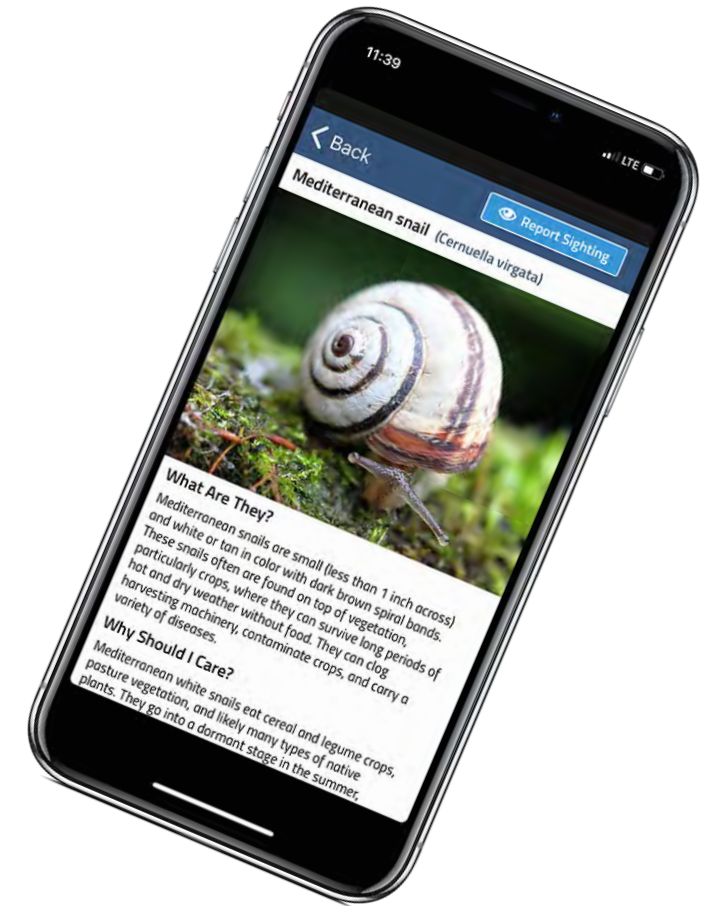
Recorded webinars with quizzes

See website for schedule

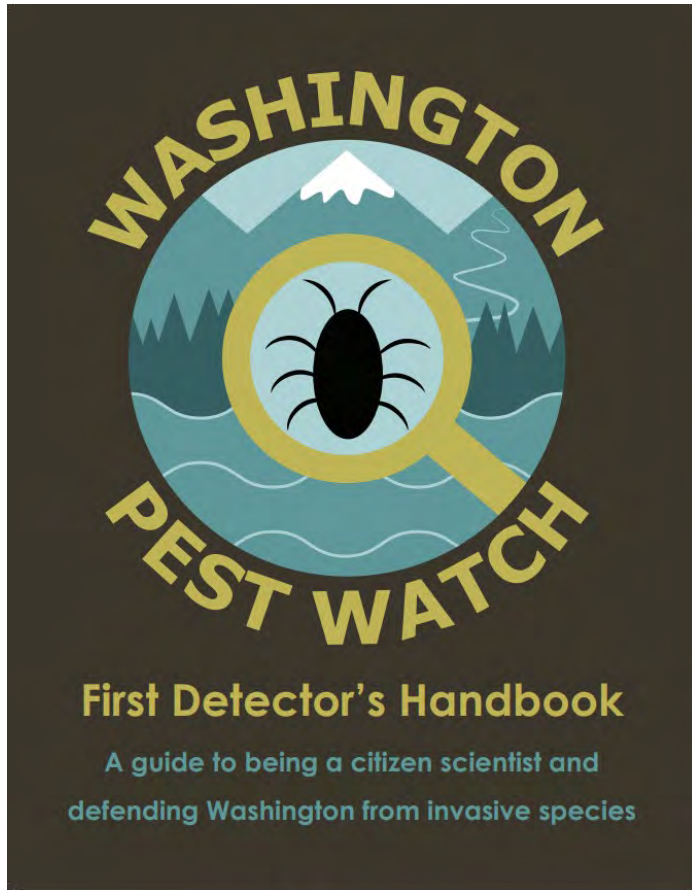
Website with educational resources

invasivespecies.wa.gov/projects/washington-pest-watch

Found at *Invasivespecies.wa.gov* > *About* > *Projects* > *Washington Pest Watch*



Strategic Plan: Education and Outreach



Nutria



Nutria are large, invasive herbivorous rodents that swim and live by water. They only eat the roots and stems of wetland plants (about 10% of the plant), which kills the entire plant. This wastefulness makes them extremely destructive to wetlands.

Resources

First Detector Handbook

Posters

Brochures

Fact Sheets

Coloring Pages

Trainer Resources

9 “canned” presentations

Plug and play



Strategic Plan: Education and Outreach

Taking good photos

Taking a photo may not always be possible, but it is extremely valuable. If possible, attach at least one photo of the invasive species you saw to your report. Here are some tips for taking good quality photos that will allow the pros to properly identify the species:

Including something for scale helps in the identification of smaller organisms. A ruler, pen, coin, etc. can be included in the photo next to the subject to convey the scale. The back of this handbook has a ruler you can use.

The lighting in the photo makes a tremendous difference about how visible the subject is.

-Light from above or the side is best.

-Indirect sunlight is ideal (direct sunlight is often too strong).

-The flash on your camera might be too strong. If so, a flashlight might provide better lighting.

-You can diffuse light for a better shot by taping a bit of vellum or 1-2 layers of tissue over the light source.



Without light diffuser (left) and with light diffuser (right).

Photos courtesy of University of Georgia 15

adapted from fact sheet by Nick Afilitto
provided by WSU
(pubs.wsu.edu)



citrus longhorned beetle, which have distinct black and white bands. The Asian longhorned beetles, however, have smooth, glossy wing covers, as opposed to the pitted, rough-textured wing covers of the Oregon fir sawyer. Further, the color of the scutellum (triangular shape between the wing covers) is different. Asian longhorned beetles have a black scutellum while the Oregon fir sawyers have a white scutellum (see right).



There is one other species worth noting that may be mistaken for Asian or citrus longhorned beetles, the native banded alder borer. This banded alder borer has very definitive black and white bands as opposed to the white dots that are characteristic of Asian and citrus longhorned beetles.



Identifying the larvae is more difficult as they are similar in appearance to native species. Mature larvae of both species are whitish in color and about 2 inches long. Like many other wood borers that are hidden underneath tree bark for most of their life, noticing declining tree health, eggs niches, exit holes, and saw dust on the tree trunk are clues of their presence.



a: Saw dust; b: Exit hole

Photos courtesy of Steven Valley, Oregon Department of Agriculture; Melody Keend and Dennis Hougen, United States Forest Service 21

Washington Pest Watch
Being a First Detector
Intro to Invasive Species
How to Report
Taking Good Photos
Fact Sheets
Insects
Diseases
Animals
Plants

Strategic Plan: Education and Outreach



Invasive Species Lesson Plans

Lesson 1: What is an Invasive Species?
Students learn about the issue of invasive species, and what they can do to prevent it!

Intended Audience
Middle School

Students Will Be Able To

- Define "invasive species"
- Describe negative impacts of invasive species
- Explain characteristics that make invasive species successful
- Describe how invasive species spread
- Identify ways to prevent and address the invasive species issue

Activities

- Explore invasive species materials
- "Introduction to Invasive Species" presentation
- Review activities:
 - Loteria game
 - Verbal or written review questions

Estimated Time
2-3 class periods

Standards Addressed

NGSS	Common Core
• MS-LS1-4	• SL.6-8.1
• MS-LS1-5	
• MS-LS2-1	
• MS-LS2-2	
• MS-LS2-4	

Introduction

An **invasive species** is a plant, animal or other organism introduced to an area outside of its native range, usually by humans, which negatively impacts the economy, environment, and health. Invasive species affect all of us, whether we realize it or not. Luckily, invasive species professionals know how to stop most invasive species but we need people's help reporting them. By learning more about invasive species in Washington, you can help report invasive species and potentially prevent the next invasion!

Materials

- "Introduction to Invasive Species" Presentation
- Loteria Game Boards (different board for each group)
- Loteria Playing Cards (1 deck)
- Space Markers (e.g. dried beans, tangrams, buttons)
- Optional:
 - Invasive Species Supply Kit
 - Prizes
 - "Introduction to Invasive Species" Guided Questions Worksheet (1 per student)
 - "Lesson 1 Review Questions" Worksheet (1 per student)

Preparation

- 1) Read the **Teacher Notes** and go through the "Introduction to Invasive Species" PowerPoint presentation to familiarize yourself with invasive species. There are guiding notes that go along with each slide to help you through the presentation.
- 2) Print the "Introduction to Invasive Species" guided questions worksheet, if using.
- 3) Select invasive species to focus on. We suggest setting up enough stations so that students can work together in small groups of 3-4.

7

Middle School Curriculum with an Elementary School Curriculum is available!

6 lessons that meet Next Generation Science Standards

Incorporate activities to support all styles of learning.

<https://invasivespecies.wa.gov/educational-materials/>

Strategic Plan: Education and Outreach

Lesson 1: Introduction to invasive

Lesson 2: BioBlitz!

Lesson 3: Be a First Detector

Lesson 4: Map the Invasion

Lesson 5: Invasive Presentation

Lesson 6: Stewardship Project



Strategic Plan: Education and Outreach

Invasive Species Toolkits

Specimens

Fact Sheets

Outreach materials

Videos (2-3 min.)

Instructional Videos



Strategic Plan



Plan Elements

- Leadership & Coordination
- Innovation and Research
- Education & Outreach
- **Prevention**
- Early Detection & Rapid Response
- Eradication, Control, and Containment

Strategic Plan: Prevention

Key Priorities

- Understand and address invasion pathways
- Response readiness
- Prevention protocols and public adoption
- Understand and address risk



Strategic Plan: Prevention



Photo: Guy Kramer



Strategic Plan: Prevention

Urban Forest Pest Steering Committee



Washington
State Department of
Agriculture



This institution is an equal
opportunity provider.



WASHINGTON STATE
UNIVERSITY



Seattle
Department of
Transportation

Photo: Guy Kramer

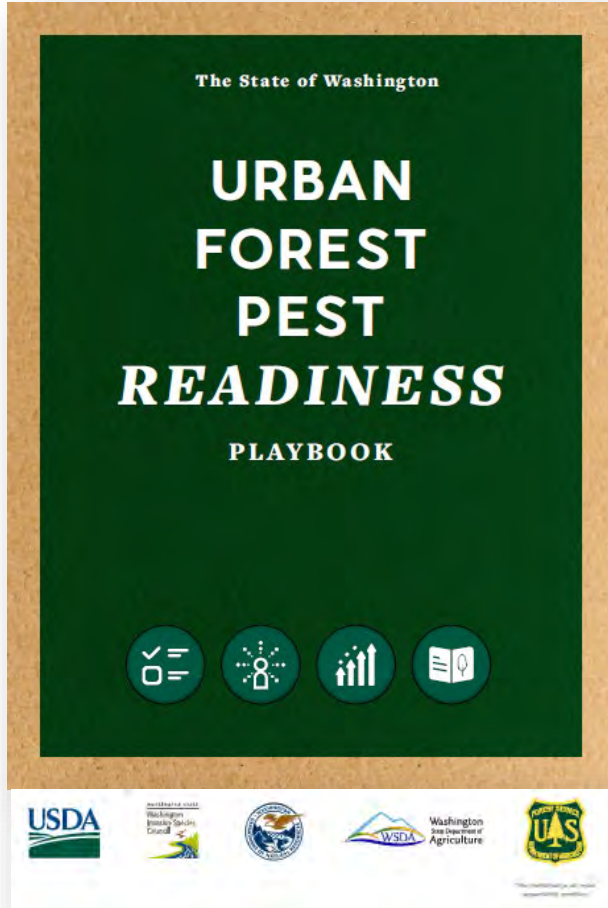


WASHINGTON STATE
RECREATION AND CONSERVATION OFFICE
Washington Invasive
Species Council

Strategic Plan: Prevention



Strategic Plan: Prevention



Executive Summary

Overview

Federal & State Authority

Supporting Organizations & Programs

Primary References

Readiness Assessment

Checklist of Readiness Actions

Strategic Plan



Plan Elements

- Leadership & Coordination
- Innovation and Research
- Education & Outreach
- Prevention
- **Early Detection & Rapid Response**
- Eradication, Control, and Containment

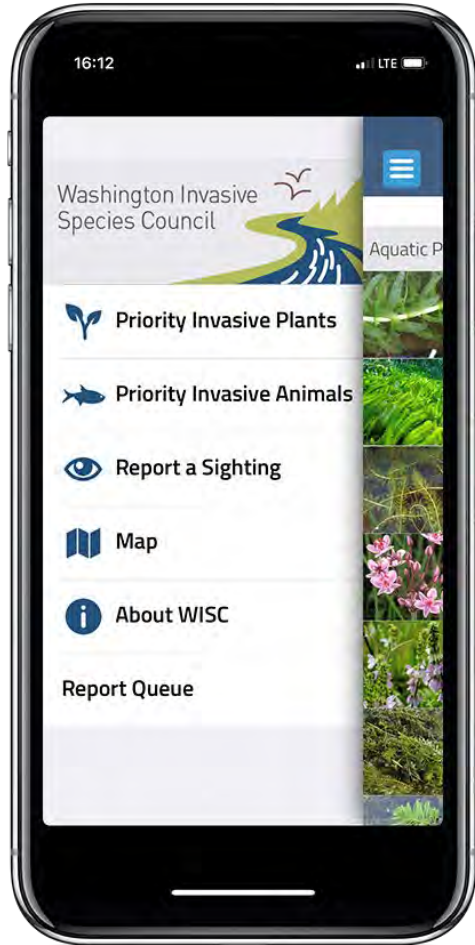
Strategic Plan: Early Detection and Rapid Response

Key Priorities

- Early detection capabilities
- Emergency funding
- Diagnosis and notification
- Response plans and exercises
- Optimizing and sharing response resources



Strategic Plan: Early Detection and Rapid Response



WA Invasives App:

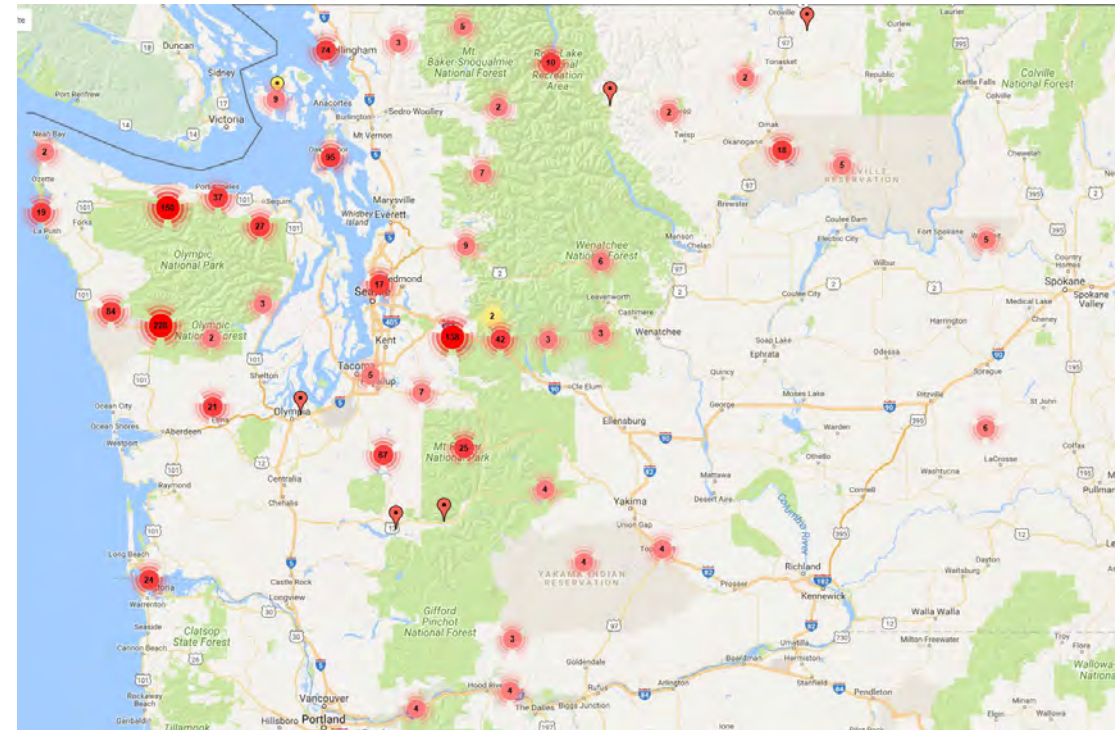
Free

Easy to use

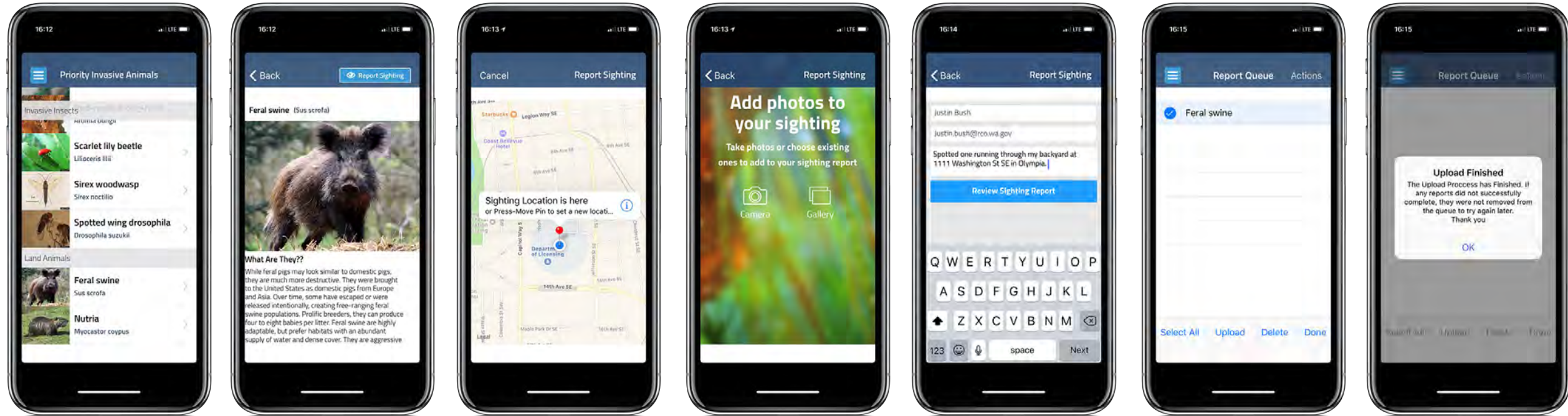
EDDMapS powered

Data improves the national map

Contains all noxious weeds



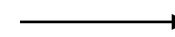
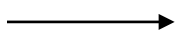
Strategic Plan: Early Detection and Rapid Response



1. Browse for ID information
2. Select species to report
3. Set location of sighting

4. Add photo
5. Write description/comments
- 6-7. Select in Report Queue & Submit report

Strategic Plan: Early Detection and Rapid Response



Verification & Action

Mobile app
iOS
Android
Website forms

Immediate notification
WISC
State/Federal
Agencies
Local Agencies

Process depends on
Lead agency(ies)
Species
Area of Report
(Distribution)

Strategic Plan: Early Detection and Rapid Response

Take away message:
See something? Say something!

1) Phone

Emergency Aquatic Invasive Species Hotline

1-888-WDFW-AIS

WA/OR/ID Feral Swine Hotline

1-888-268-9219

2) Mobile app

WA Invasives for iOS and Android

3) Website

<http://www.invasivespecies.wa.gov/report.shtml>



Strategic Plan



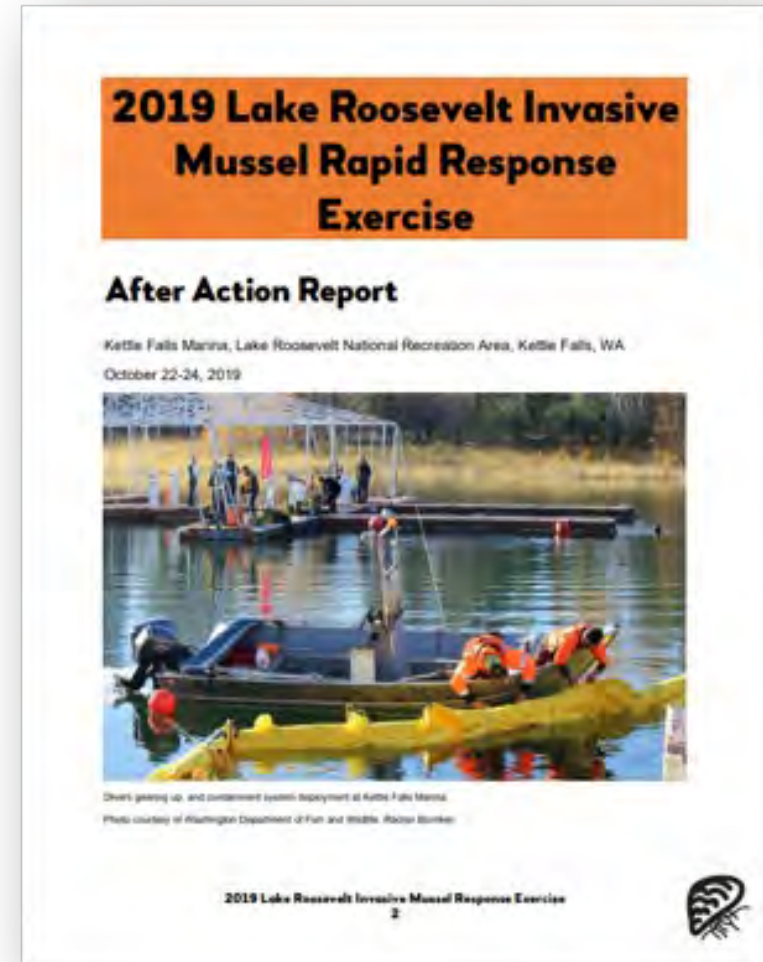
Plan Elements

- Leadership & Coordination
- Innovation and Research
- Education & Outreach
- Prevention
- Early Detection & Rapid Response
- **Eradication, Control, and Containment**

Strategic Plan: Eradication, Control, and Containment

Key Priorities

- Adequate and sustainable funding
- Data collection, sharing, and mobilization
- Optimization of response operations
- Asset-based management for protection and natural or economic assets
- Evaluation and re-evaluation



What sets WISC apart?

- Takes a statewide perspective
- Has the obligation to think about ALL invasive species issues: plants, animal, insect, disease, aquatic, etc.
- Collaborates with others to fill gaps and identify needs
- Focuses on outreach and education, reporting, and collaboration



How WISC can support WCMAC

- Voice support for the community jobs program
- Fill gaps
- Assist in collaboration and connection
- Spread awareness of issues through education and outreach



Questions?

QUALITATIVE NETWORK ANALYSIS OF NEW OCEAN USES IN WASHINGTON STATE WATERS

Robert P. Wildermuth¹, Teresa Pucylowski², Casey Dennehy², Gavin Fay¹,
Chris Harvey³, P. Sean McDonald⁴, Susan Gulick⁵

WCMAC, March 17, 2021

¹ University of Massachusetts Dartmouth

² Washington Department of Ecology

³ Northwest Fisheries Science Center, NOAA NMFS

⁴ University of Washington

⁵ Sound Resolutions

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Goal

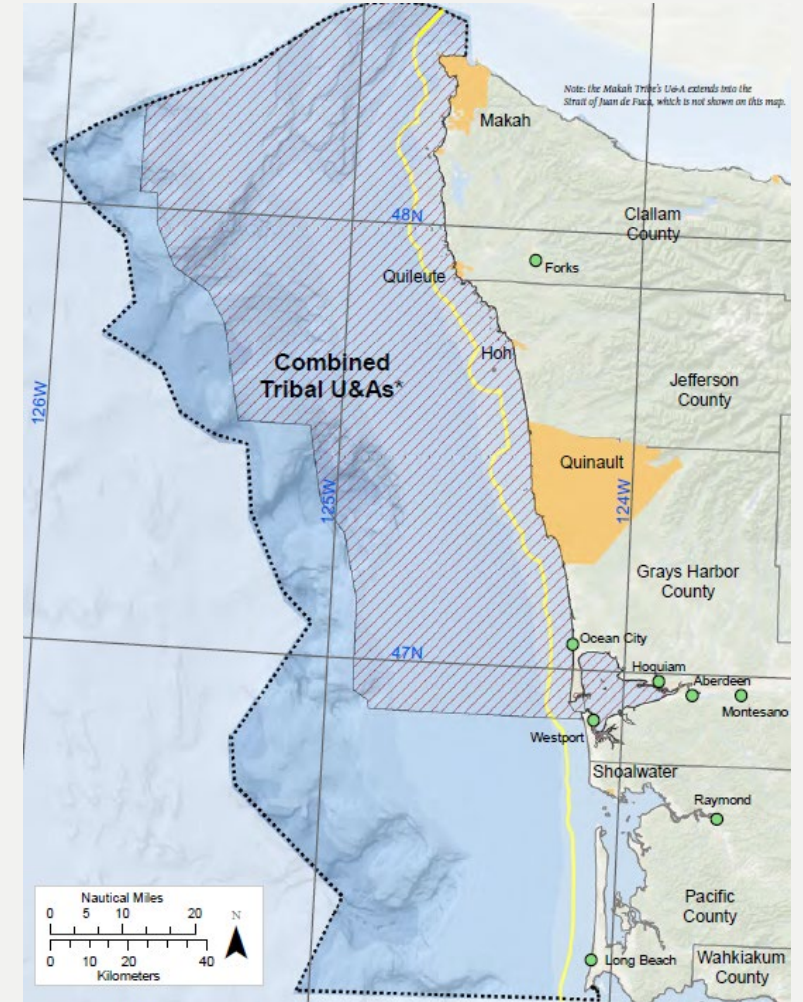
Tasked by WA Dept. of Ecology to provide model-based advice for:

- Development of indicators to track and report on
- Guiding management of new ocean uses
 - *Offshore finfish aquaculture*
 - *Offshore wind development*
 - *Seabed mining*

Supports directives of the Washington Marine Spatial Plan

Builds from the MSP Indicators report (Andrews et al. 2015)

WA MSP Study Area in state, federal, and tribal U&A waters



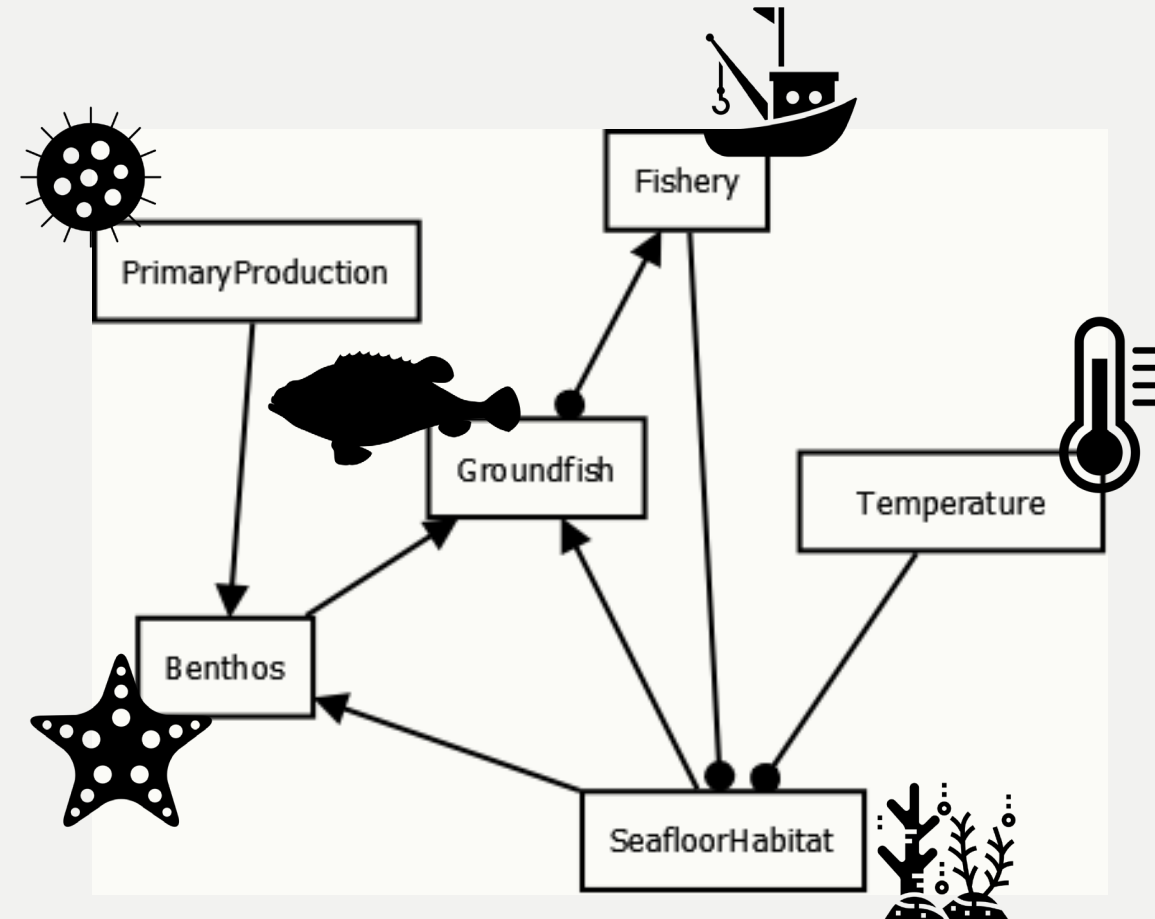
WA MSP 2017

Outline

- Modeling Background
- Development of Model Structures
 - Review of Expert Workshop Outcomes
- Scenario Application
- Overview of Outcomes and Results
- Advice and Next Steps

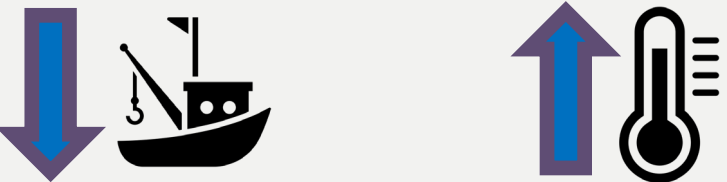
Why Qualitative Network Modeling?

- Gives indication of indirect effects of pressures in a system
- Uses expert knowledge and simplifying assumptions
- Describes wide range of variables without need of quantitative data




Simulating change

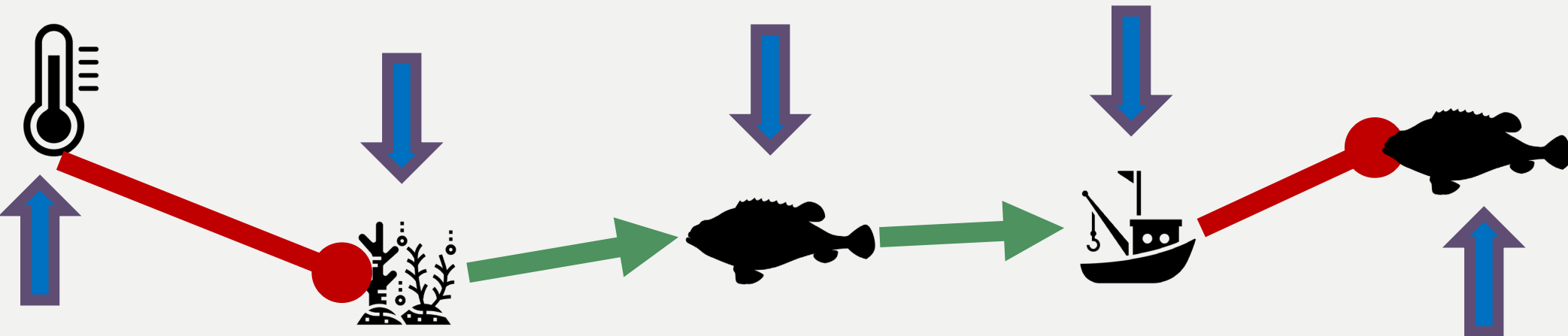
- Evaluate how system responds to a consistent increased temperature and reduced fishing



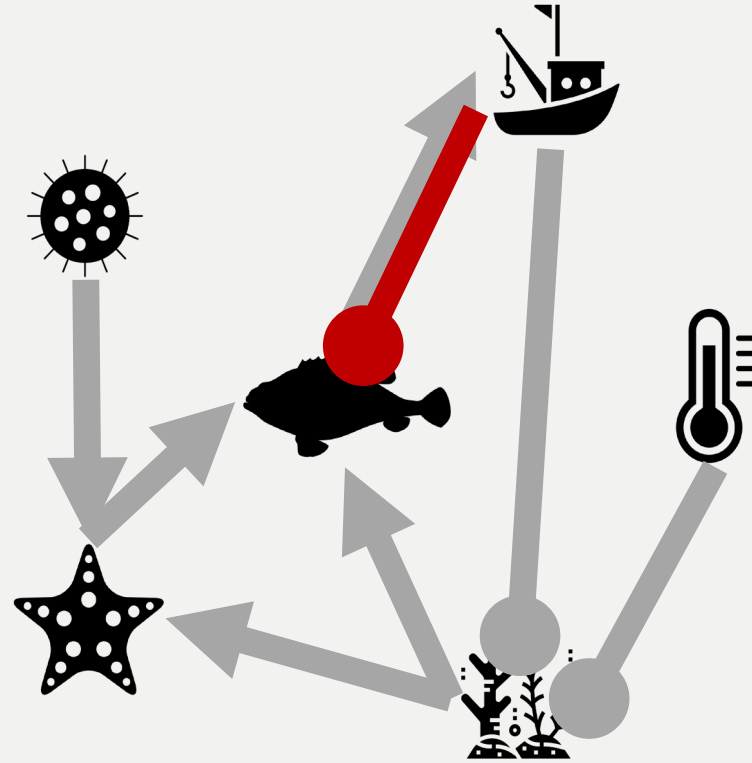
Interactions are:

- positive 
- negative 
- *No magnitudes*

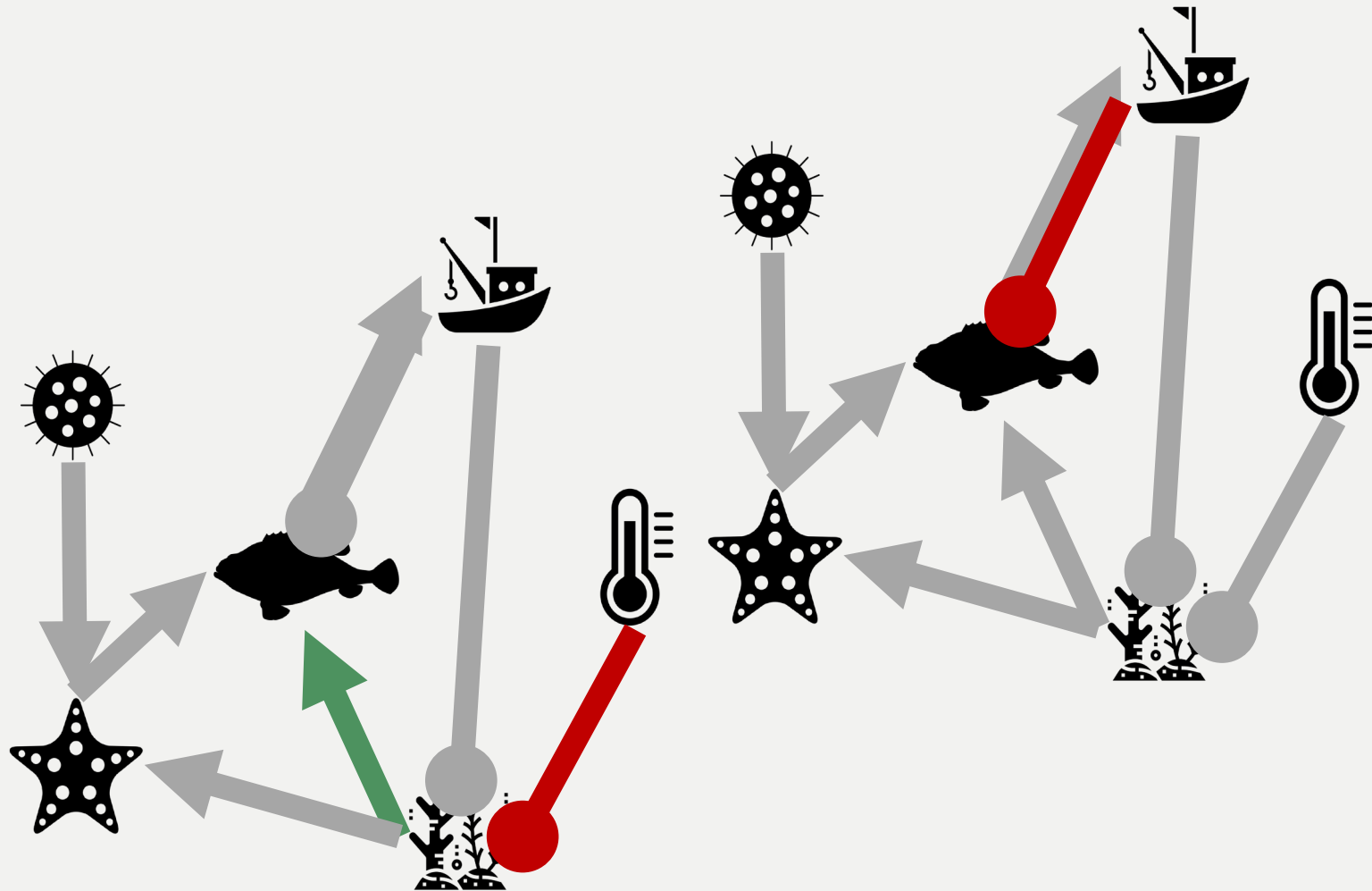
- Think of a seesaw:



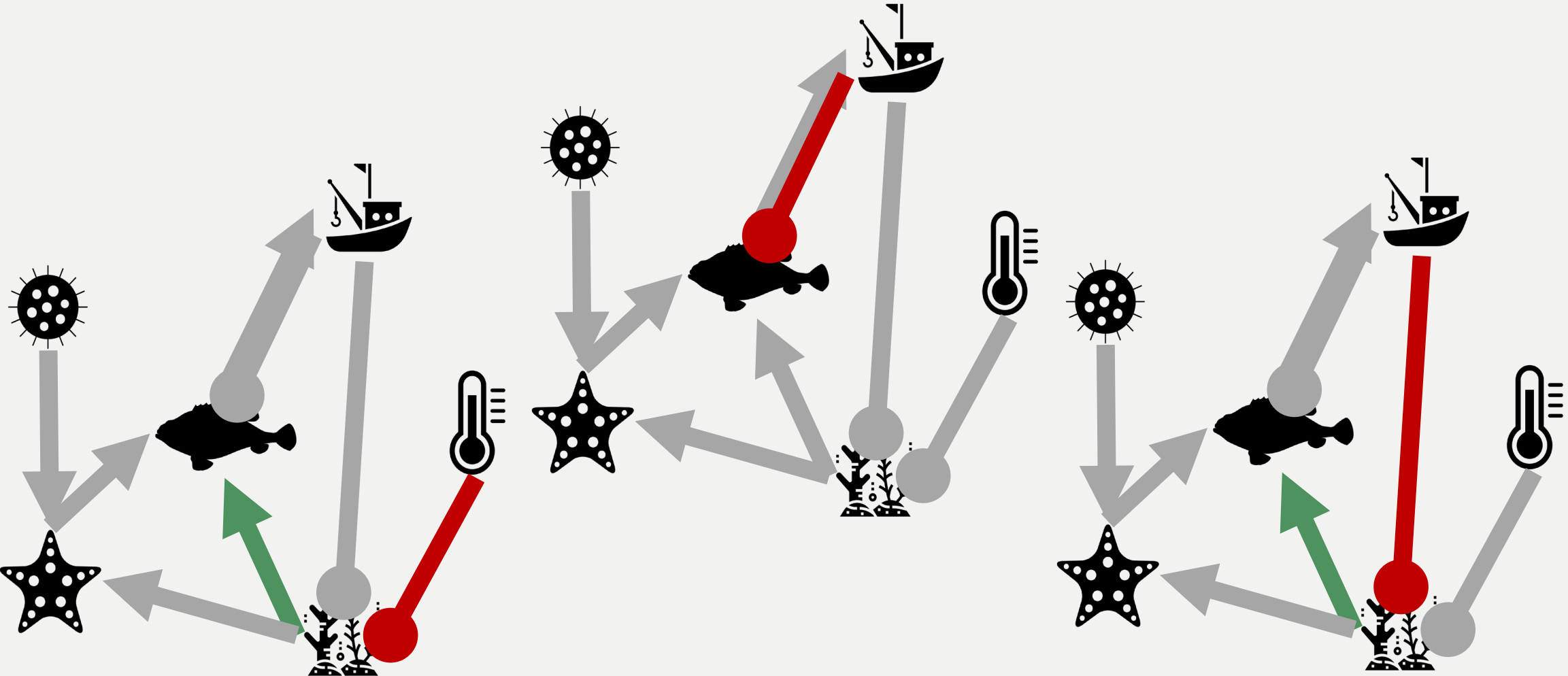
Simulating change



Simulating change



Simulating change



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Habitat models for the Washington Marine Spatial Plan

- The Marine Spatial Plan (2017) and Andrews et al. (2015) define habitats in waters of Washington's outer coast
 - *Conceptual models and indicator data*

- **Case Study Systems:**

- *Seafloor*
- *Kelp Forest*

Component	Attribute	Indicator	Time period of available data
Physical drivers			
Climatic	Water temperature	Seafloor temperature	2003 – 2014
		Pacific Decadal Oscillation	1900 – 2015
	El Niño events	Multivariate El Niño Index	1950 – 2015
		Northern Oscillation Index	1948 – 2014
	Source waters	North Pacific Gyre Oscillation index	1950 – 2015
Northern copepod anomaly		1996 – 2015	
Oceanographic	Upwelling	Upwelling index	1967 – 2014
		Spring transition index	1967 – 2015
	Currents, eddies, plumes	Columbia River plume volume	1999 – 2014
		DO continental shelf/slope	2009 - 2014
	Low dissolved oxygen (DO) events	DO at Newport, OR, 150 m	1998 - 2014
Area of hypoxia (Sept)		2006 - 2012	
Habitat			
Physical and biogenic habitat	Quantity	Substrate type map	NA
		Biogenic habitat map	NA
	Quality	Seafloor temperature	2003 – 2012
		DO continental shelf/slope	2009 - 2014
		DO at Newport, OR, 150 m	1998 - 2014
Ecological components	Population size	Phytoplankton biomass	NA†
		Population condition	Diatoms: dinoflagellate ratio

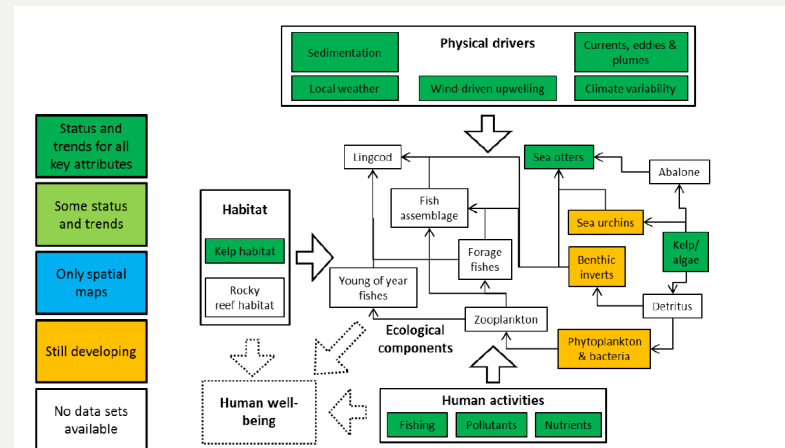
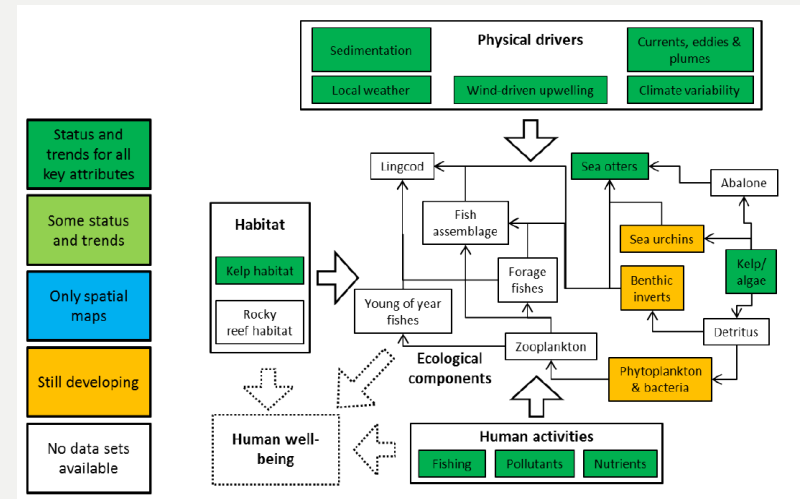
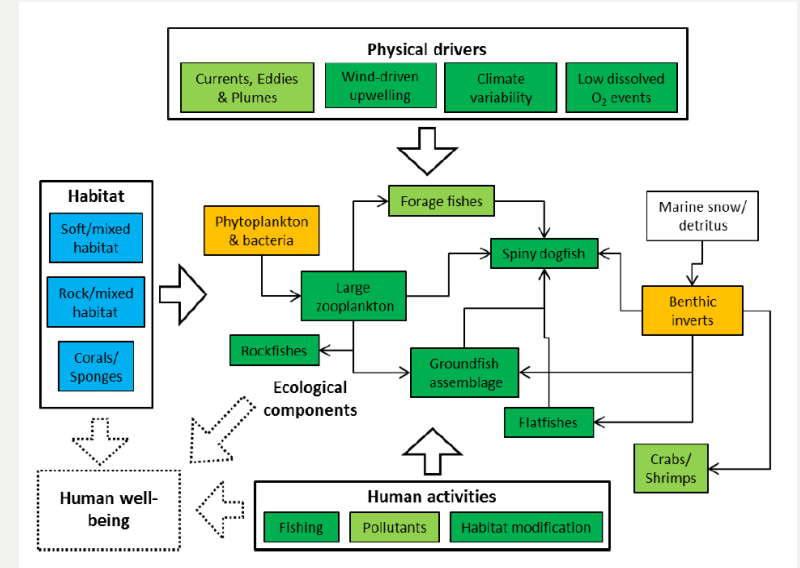


Figure 127. Present status and data gaps for the important components of the kelp forest habitat's conceptual model in WAMSP waters.

Expert Workshop Goals

- Translate conceptual models into networks
 - Started with WA Ecosystem Indicator report (Andrews et al. 2015)
 - Ranking of important variables to human wellbeing and system function
- Provide additional resources



Expert Workshop

- 29 participants on Day 1
- 31 on Day 2
- 17 participants filled out pre-workshop survey
 - *183 years of total experience*
 - *Mostly resource managers (6), ecology experts (7), and federal employees (7)*

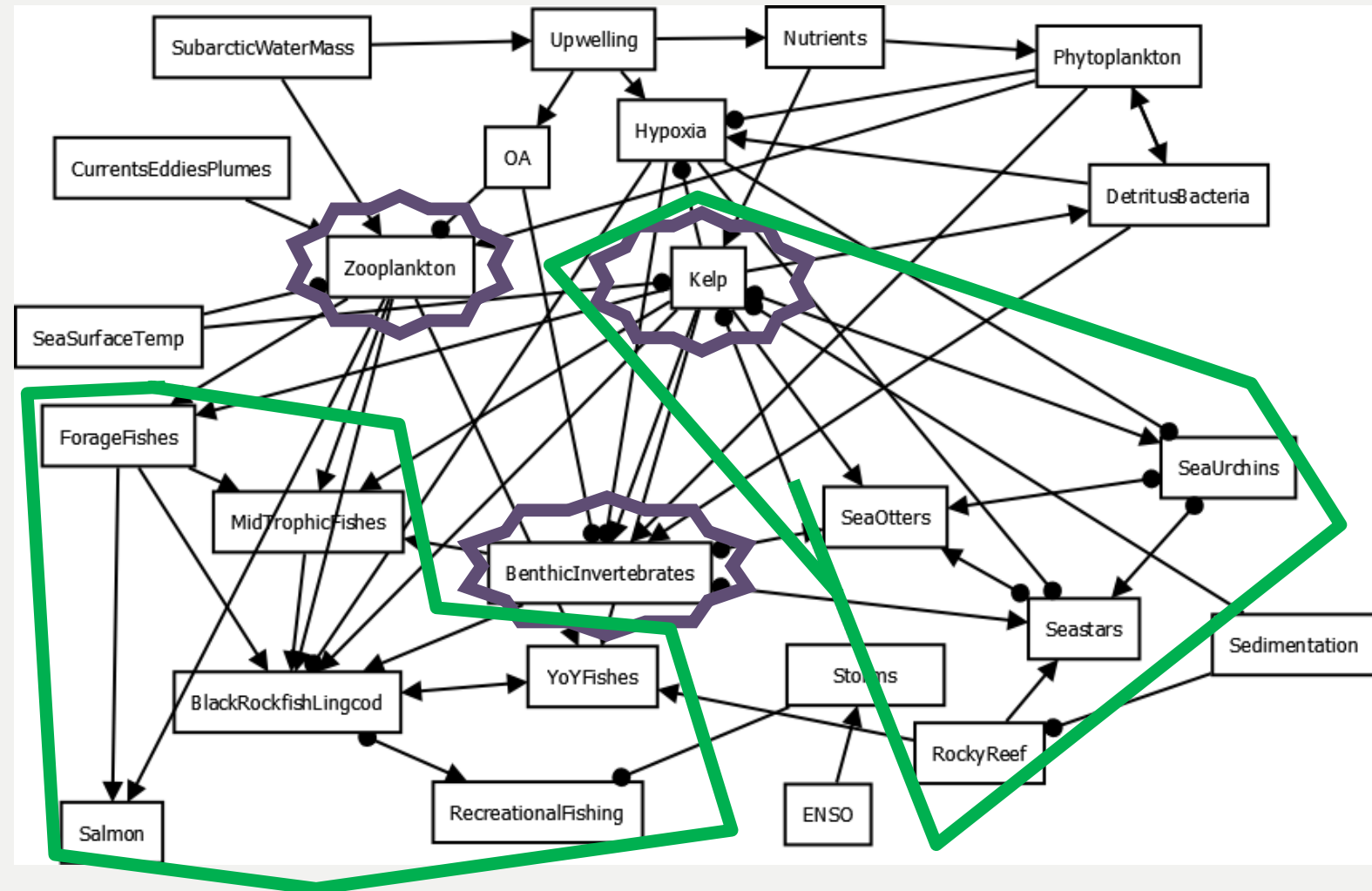
Highly Ranked Model Elements

Kelp Forest	Seafloor
Kelp Habitat	Hypoxia (Dissolved Oxygen)
Nutrients	Fishing
Rocky Reef Habitat	Crabs (& Shrimps)
Sea Surface Temperature	Upwelling
Sea Urchins	Benthic Invertebrates

Kelp forest model

- 26 Model Elements
- Kelp, Zooplankton, and Benthic Invertebrates highly connected
- 2 sub-networks
 - *Sea Otters and Sea Urchins*
 - *Managed fish groups*

Draft QNM



Scenario Evaluations

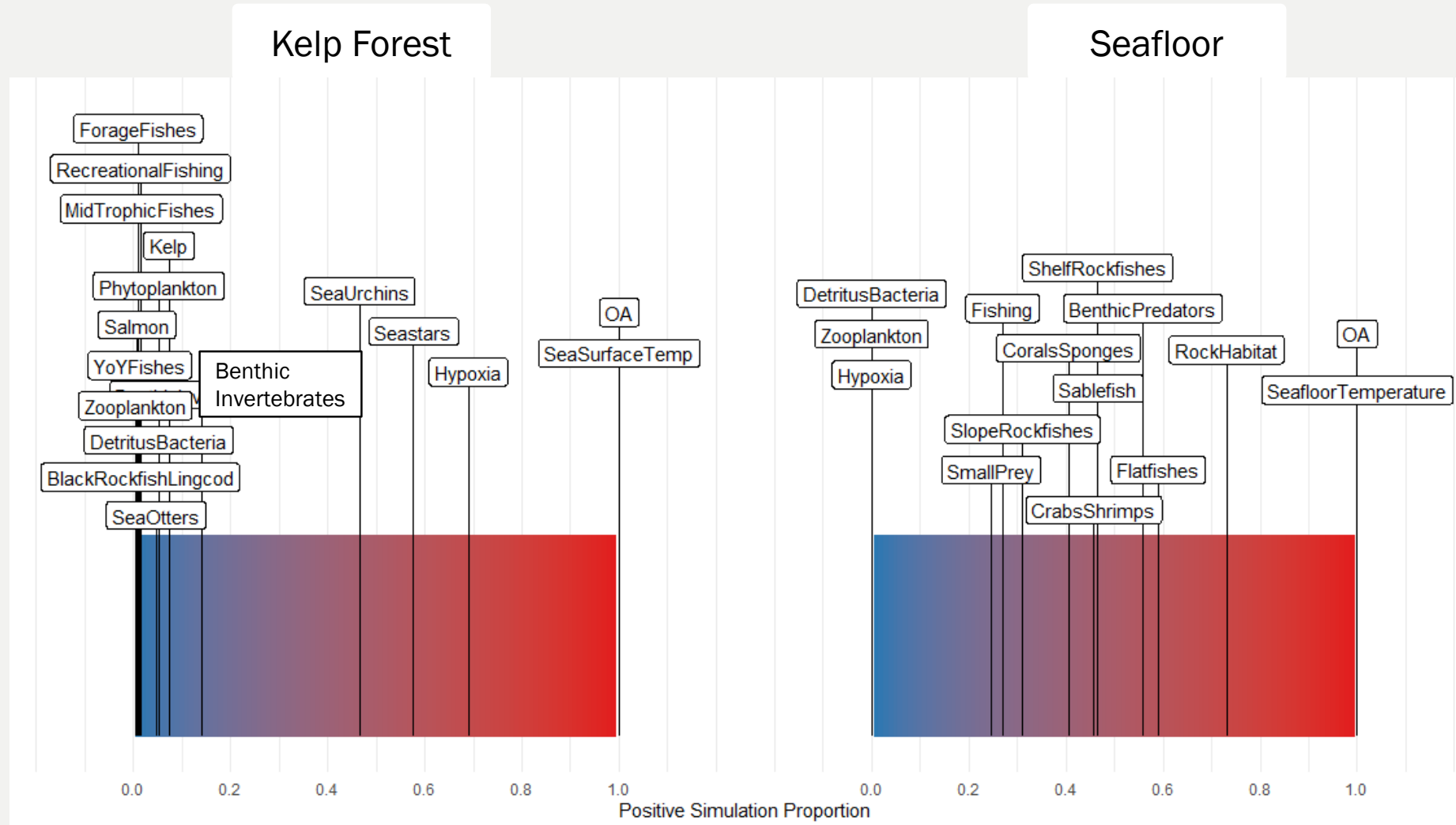
Scenario	Kelp Forest	Seafloor
Climate Change	↑ Ocean Acidification, Surface Temperature	↑ Ocean Acidification, Seafloor Temperature
+ Finfish Aquaculture	↑ Detritus & Bacteria, Nutrients, Sedimentation, and Forage Fishes ↓ Recreational Fishing and Salmon	↑ Detritus & Bacteria, Pollution, Small Prey, and Corals & Sponges ↓ Fishing and Soft Habitat
+ Offshore Wind Development	↑ Detritus & Bacteria, Recreational Fishing, Forage Fishes, Currents, Eddies & Plumes ↓ Rocky Reef	↑ Small Prey and Corals & Sponges ↓ Fishing, Rock Habitat, and Soft Habitat
+ Seabed Mining of Sand	↑ Sedimentation and Hypoxia ↓ Recreational Fishing, Benthic Invertebrates, and Rocky Reef	↑ Hypoxia ↓ Fishing, Rock Habitat, Soft Habitat, and Small Prey

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Results: Climate Change

Increased: ■
Decreased: ■



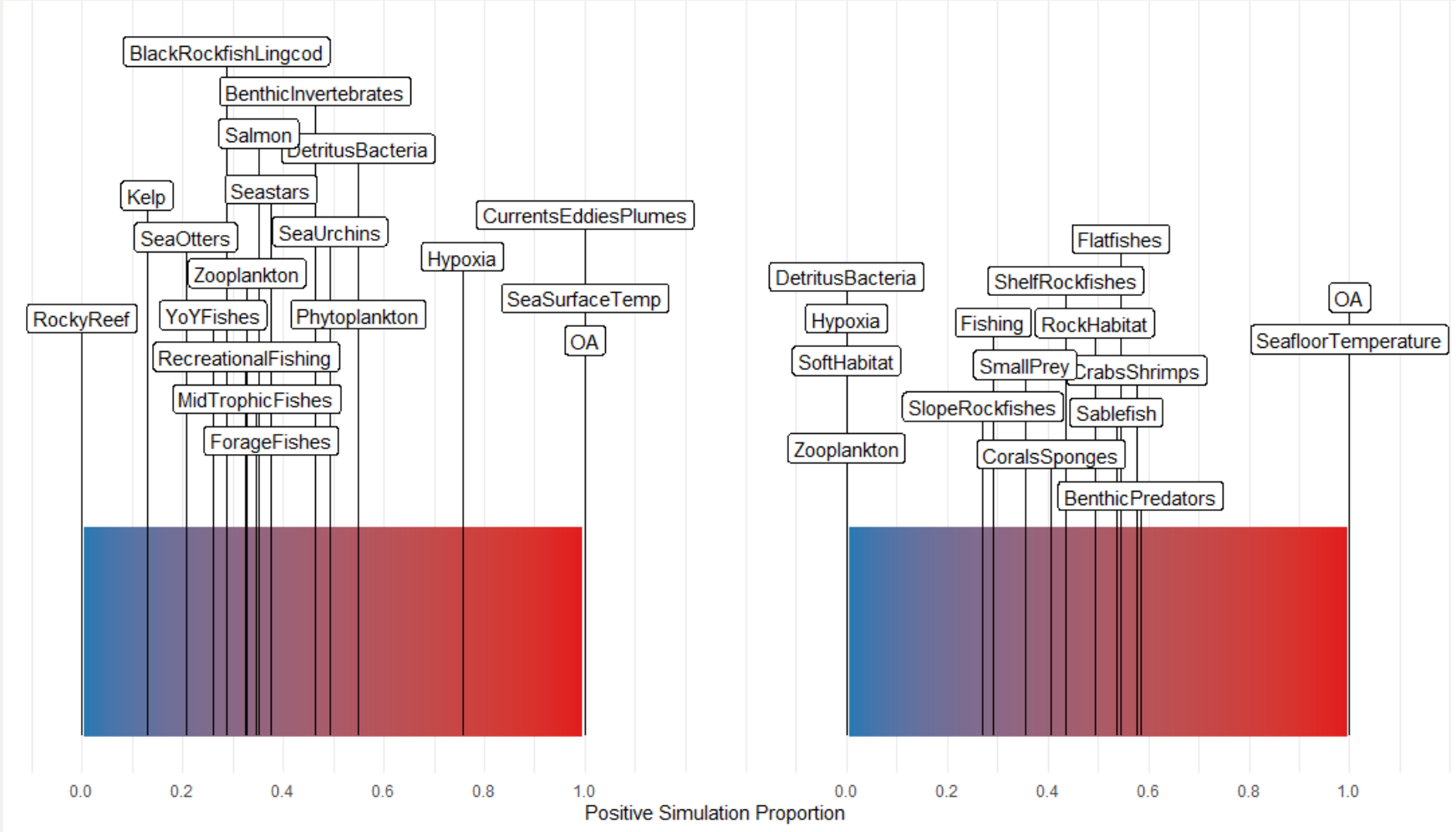
Unaffected:
 ENSO
 Pollution
 Seafood
 Demand
 Soft Habitat
 Subarctic Water
 Mass
 Upwelling
 Currents, Eddies
 & Plumes
 Nutrients
 Rocky Reef
 Sedimentation
 Storms

Results: Wind Development

Increased: ■
 Decreased: ■

Kelp Forest

Seafloor



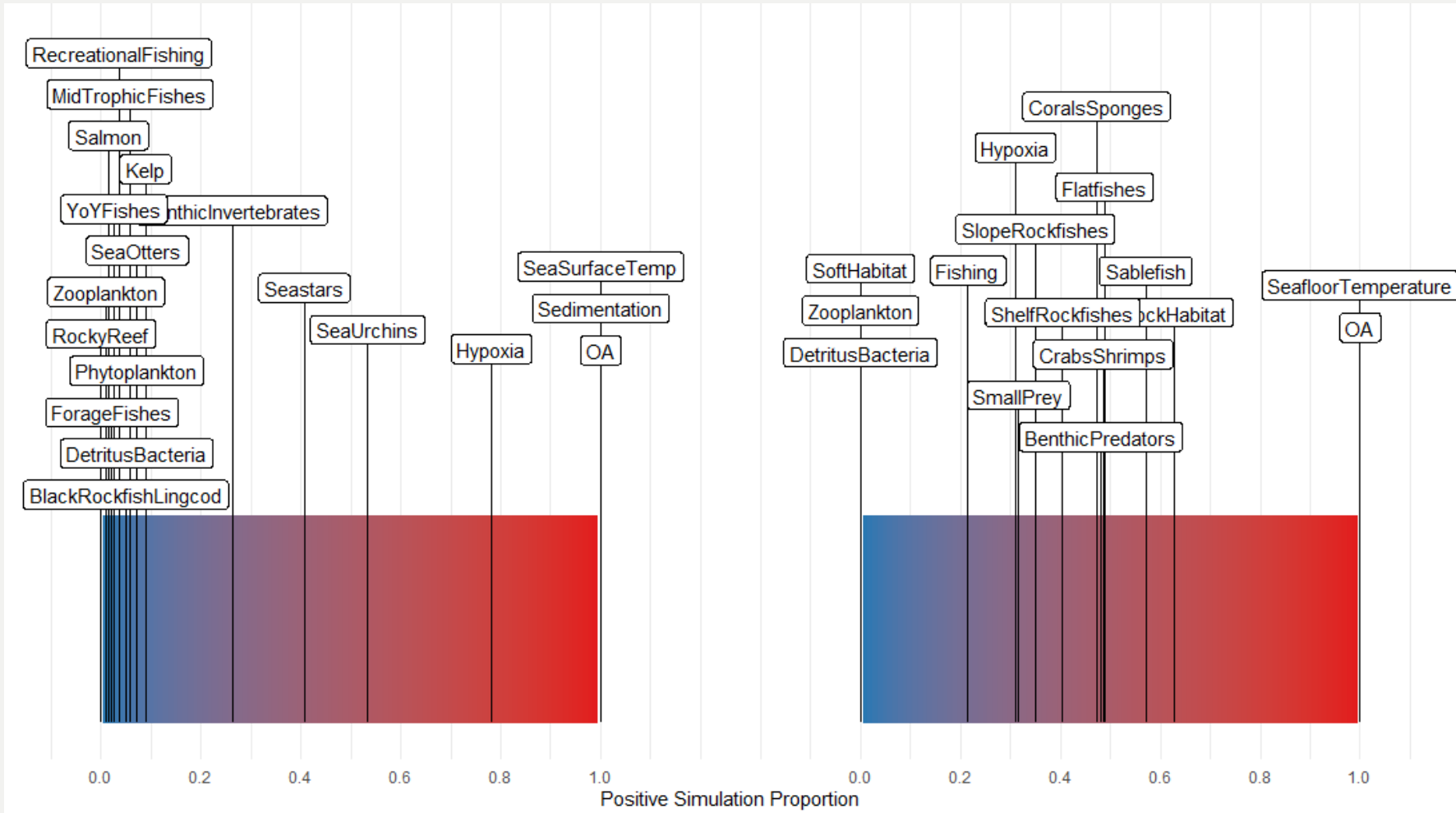
Unaffected:
 ENSO
 Pollution
 Seafood Demand
 Subarctic Water
 Mass
 Upwelling
 Nutrients
 Storms
 Sedimentation

Results: Seabed Mining

Increased: ■
Decreased: ■

Kelp Forest

Seafloor



Unaffected:
ENSO
Pollution
Seafood Demand
Subarctic Water
Mass
Upwelling
Currents, Eddies
& Plumes
Nutrients
Storms

General Outcomes & Advice

- Climate change increased uncertainty in outcomes across scenarios and model elements
 - *More unfavored outcomes in Kelp Forest system*
- Negative effects on fishing and fished groups in both systems
- Negative impacts on soft substrate and kelp habitats
- Zooplankton and forage fish groups indicate bottom-up effects on fished groups
- Further study of highly connected nodes needed to improve understanding of system and new use impacts
 - *Crabs & Shrimp, Kelp Habitat, Fishing, and forage species*

Next Steps

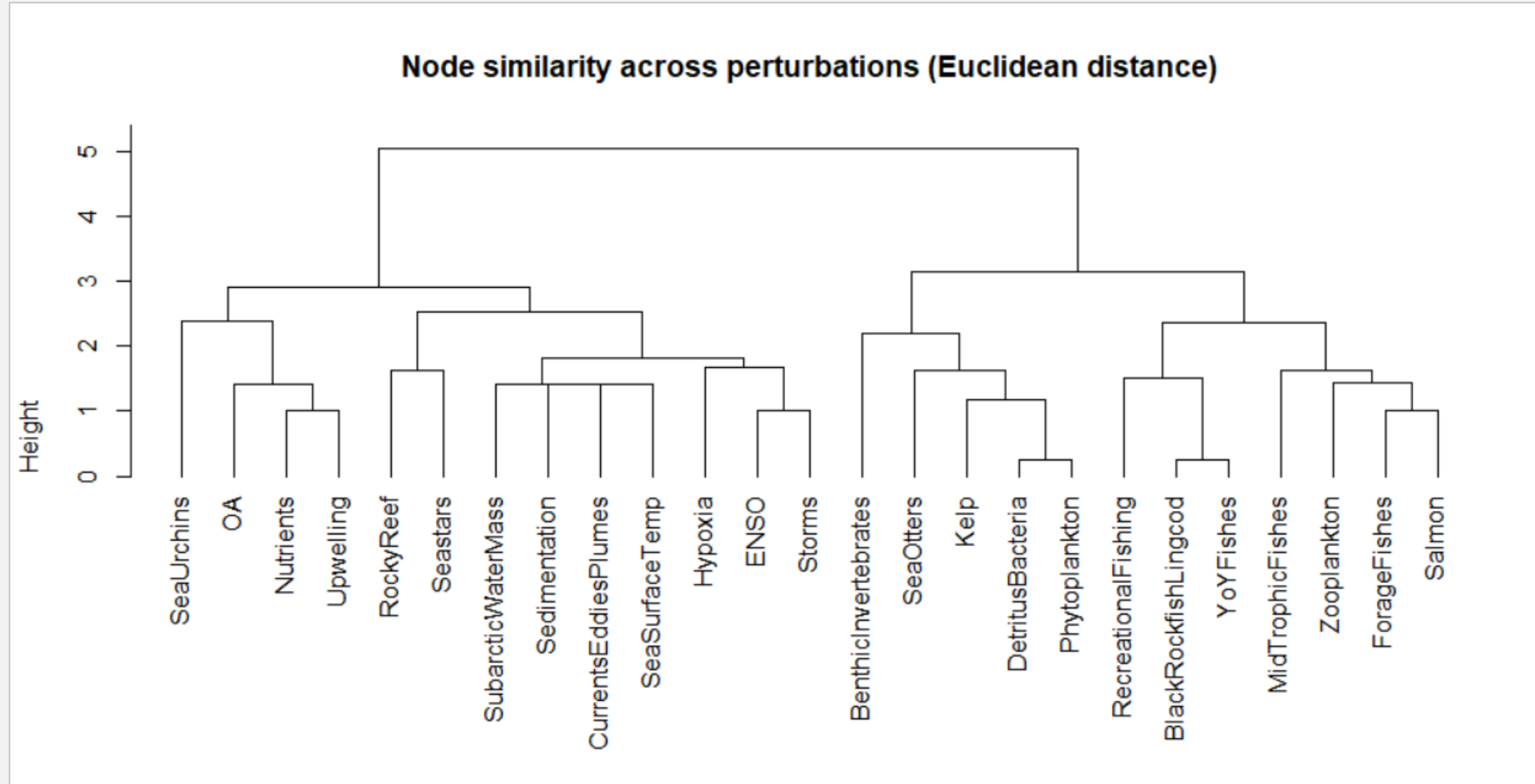
- Identify additional links to social, economic, and cultural components
 - *Tribal Usual & Accustomed fishing grounds*
 - *Kelp harvest*
 - *Discards*
 - *Clarity in defining Pollution*
 - *Disturbance of structural biotic elements*
 - *Connections to orca populations*
 - *Job quality*
 - *Subsistence and food provision*
 - *Resource access and tenure*
 - *Local and informal economies*
 - *Sense of place*
 - *Cultural values and practices*
 - *Emotional and mental health*
- Code and methodology available to apply toward other MSP habitat systems
 - https://github.com/rwildermuth/WA_QNM_MSP

Contact information

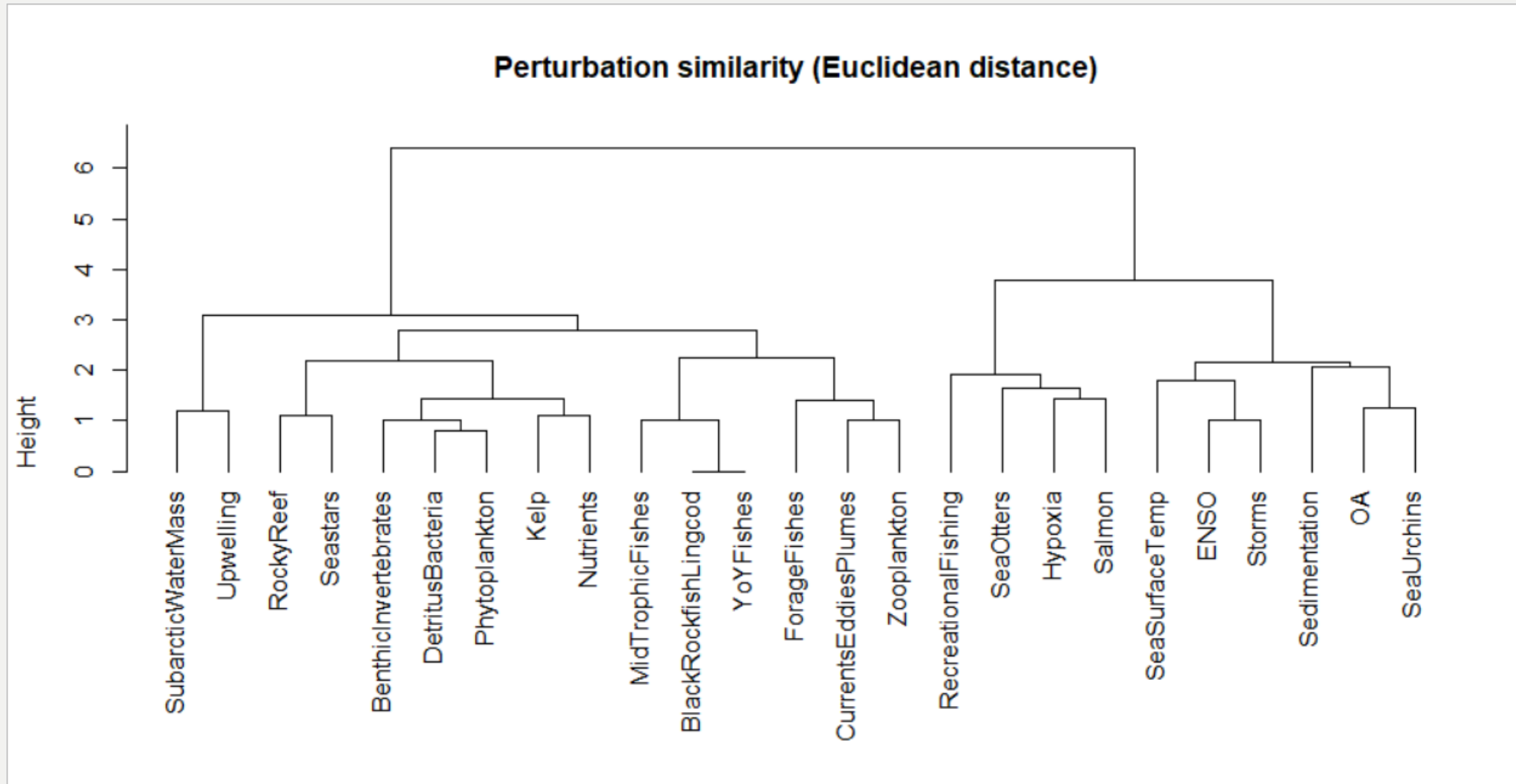
Questions or suggestions

- Robert Wildermuth
- RWildermuth@umassd.edu

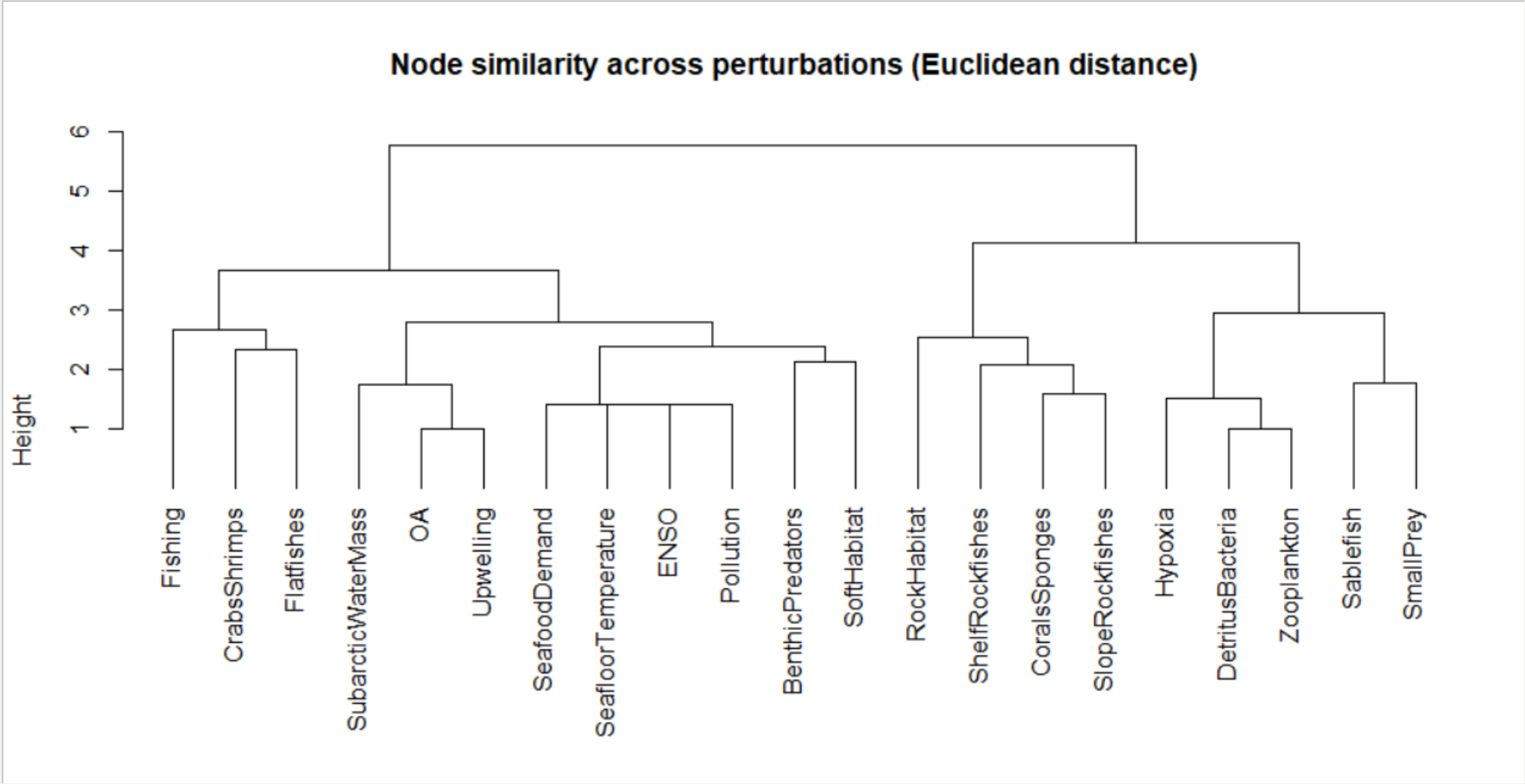
Kelp Forest – indicator correlation



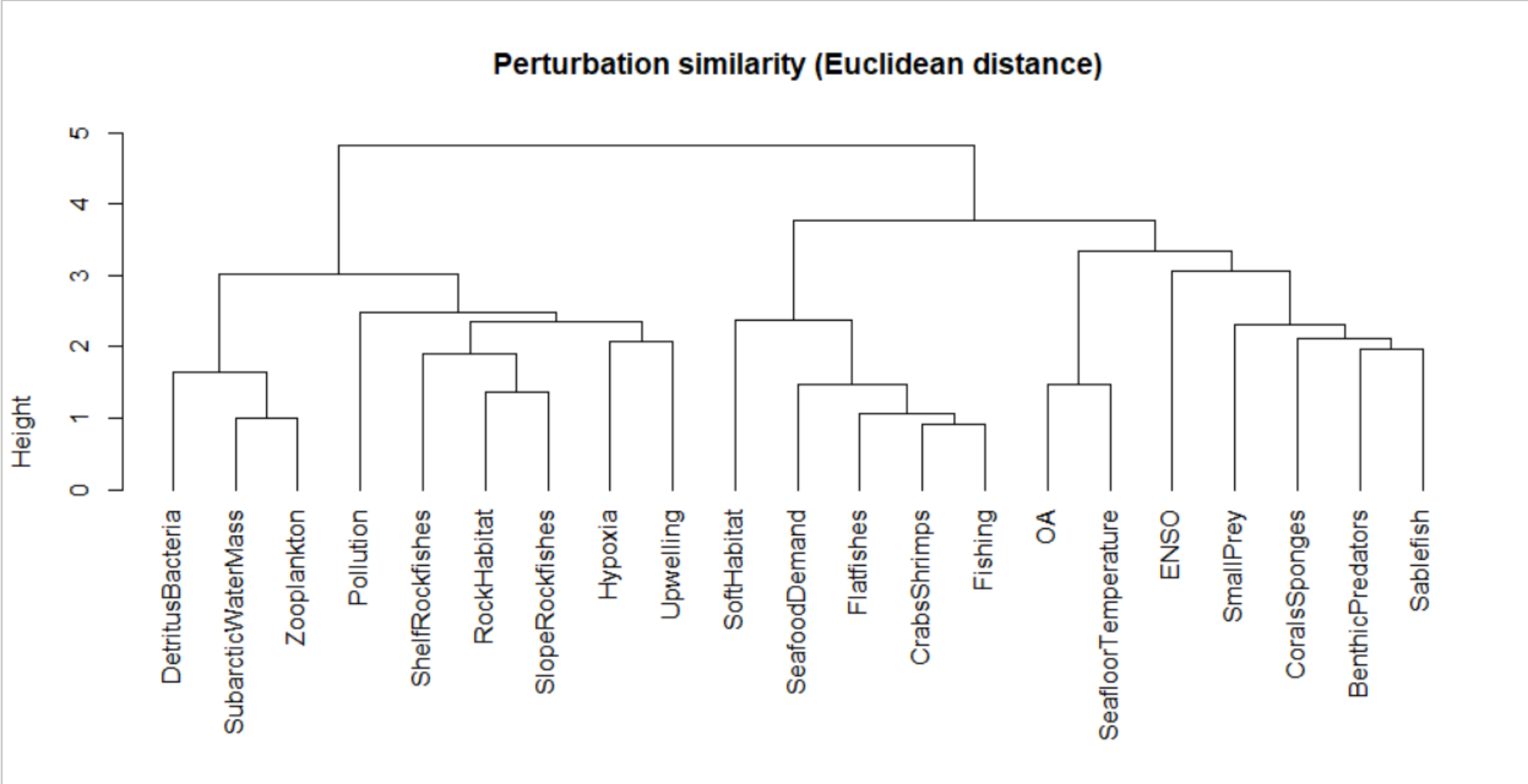
Kelp Forest – correlation in effects



Seafloor - indicator correlation



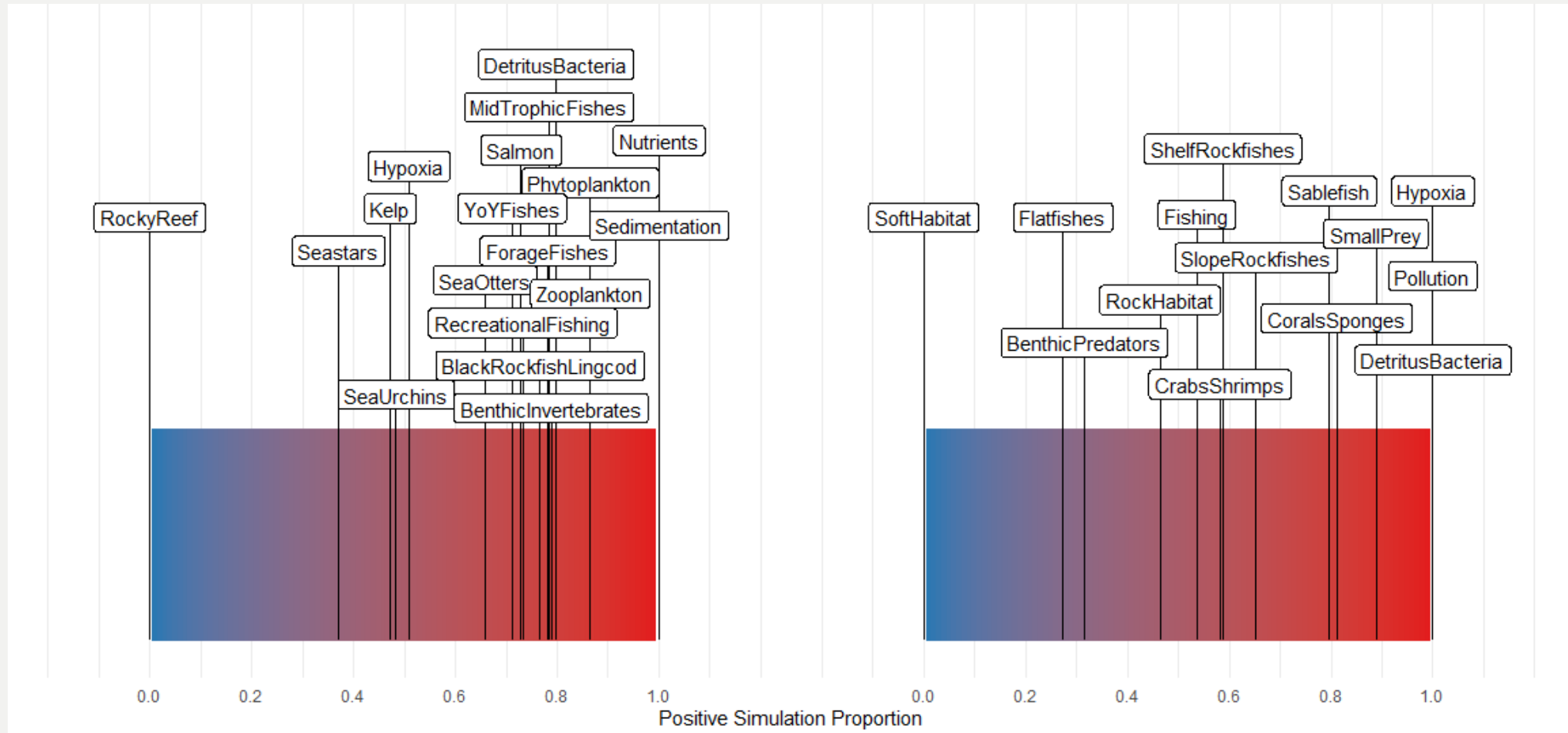
Seafloor – correlation in effects



Results: Finfish Aquaculture No CC

Kelp Forest

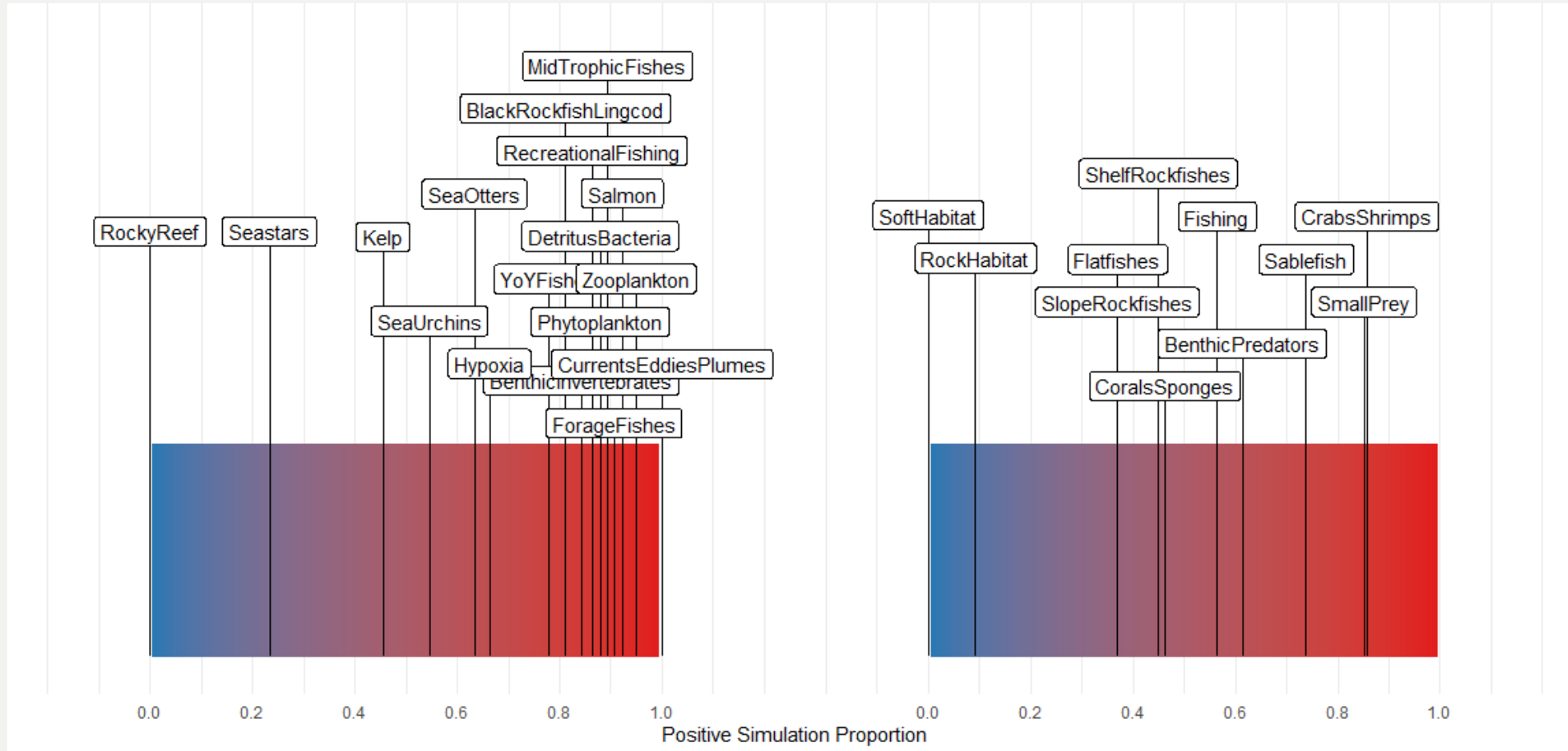
Seafloor



Results: Wind Development No CC

Kelp Forest

Seafloor



Results: Seabed Mining No CC

