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Improving Eelgrass (*Zostera marina* L.) Restoration, Conservation, and Protection

Model Output Refinement and Regulatory Recommendations

June 2014

JL Gaeckle – Washington State Department of Natural Resources
LM Aston – Pacific Northwest National Laboratory

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June 2014

Prepared for the
Washington State Department of Natural Resources

Pacific Northwest National Laboratory
Sequim, Washington

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Acronyms and Abbreviations

DNR	Department of Natural Resources
Ecology	(Washington State) Department of Ecology
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
GPS	Global Positioning System
HPA	Hydraulic Project Approval
PERS	Pacific Estuarine Research Society
WDFW	Washington Department of Fish and Wildlife
NOAA	National Oceanic and Atmospheric Administration
USACE	U.S. Army Corps of Engineers
WSDOT	Washington State Department of Transportation
WA	Washington

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1.0 Introduction

The eelgrass (*Zostera marina* L.) transplant suitability model for Puget Sound integrated a hydrodynamic and eelgrass biomass model to identify sites suitable for eelgrass transplantation. The integration of the three models improved output by encompassing a range of environmental conditions and variability at individual sites. Although a substantial amount of environmental data is available to parameterize the model, further refinement and additional information to filter model outputs is always desired to optimize eelgrass transplant success. Additional data, such as eelgrass presence or absence, will be included to refine model outputs, but other information could be useful to improve model accuracy, eelgrass transplant site selection, and transplant success. The additional data include information about the historical or recent past distribution of eelgrass in an area, known causes for eelgrass decline in an area, and current site-specific stressors. This information will help identify potential eelgrass transplant sites that the model did not select, refine model output to a specific area at a site, or identify known stressor-abatement activities that need to be performed prior to eelgrass transplantation.

In addition to acquiring information that will enhance eelgrass transplantation, understanding and addressing the barriers to effective regulation and stewardship will improve the protection and conservation of this critical resource in Puget Sound. It is important to understand whether regulations to protect and conserve eelgrass are effective by asking some specific questions such as: does the “no-net-loss” shoreline policy work, are mitigation ratios adequate, are monitoring restoration and mitigation efforts adequate, and are restoration and mitigation areas protected from further impacts? While the data on historical distribution and stressors (applied as a filter to model outputs) will improve transplant site selection, effective regulations and stewardship of eelgrass will protect and conserve this resource through regulatory and educational means.

The acquisition of supplementary data, as described in this task report, will support eelgrass transplant site selection prioritization, enhance eelgrass transplant success, and improve the protection and conservation of eelgrass resources in Puget Sound. The ensuing sections of this report describe task methods, results derived from the methods—presentations by and discussions with stakeholders and survey of stakeholders—and related discussion. Appendixes contain supplemental information.

2.0 Methods

The acquisition of additional data to support eelgrass transplant site selection and prioritization and to further enhance the knowledge of regulatory barriers that impede eelgrass protection and conservation was completed through two channels. One method was to conduct presentations and hold discussions with shoreline managers and regulators, tribal members, academics and research scientists, and citizen groups that have a keen interest in nearshore marine vegetation. The information source, method of contact (e.g., phone conversations, during impromptu meetings, or at conferences) and location or venue where the information was acquired is listed in Appendix A. A copy of a poster that was presented at one of the venues listed in Appendix A is provided in Appendix B.

The other method by which information was acquired was through an online survey (Google forms, see Appendix C). A link to the online survey was distributed to individuals and multiple listserv groups that are interested in the health of Puget Sound and natural resources in general. In many cases, there was overlap between the sources contacted in Appendix A and those who were surveyed. The survey questions provided a more standardized method of acquiring information and the results provide the most data for this task. Survey responses are provided in Appendix D.

Survey questions focused on stressors that affect eelgrass in Puget Sound, the effectiveness of regulatory structures designed to protect eelgrass, eelgrass restoration success, and mitigation ratios. There were also opportunities for survey participants to provide specific details about sites where eelgrass once grew and, with site-specific stressor-abatement efforts, where it could potentially be restored.

3.0 Results

Results were derived from meeting presentations, interaction with stakeholders, and from responses to an online survey.

3.1 Results of Presentations and Discussions

Presentations and conversations with shoreline managers and regulators, tribal members, academics/research scientists, and citizen groups that have a keen interest in nearshore marine vegetation were held at different times throughout the project. Results of these discussions are summarized in the following sections.

3.1.1 Pacific Estuarine Research Society

An interactive poster titled “We Need 20% More Eelgrass” was presented at the Pacific Estuarine Research Society (PERS) annual meeting in Anacortes, Washington, on April 12-14, 2012. The poster presented the current known distribution of eelgrass (*Zostera marina* L.) in Puget Sound based on data collected by Washington State’s Department of Natural Resources (e.g., Submerged Vegetation Monitoring Program and ShoreZone) and allowed for meeting participants to contribute information to the poster (Appendix B). The information added to the poster included locations where eelgrass is present but not represented correctly on the poster, locations where eelgrass once grew but is no longer present, and locations where eelgrass restoration activities may be successful. In addition, the poster provided viewers an opportunity to include information about stressors affecting eelgrass in Puget Sound and the effectiveness of regulations that protect or conserve eelgrass. The responses to the poster were limited, likely a result of the low conference participation, but overall the responses provided valuable information about eelgrass distribution and stressors and regulatory barriers that affect eelgrass in Puget Sound. The participants added the following comments to the poster:

- Response on regulatory barriers
 - Tideland ownership limits ability to restore or enhance eelgrass on tidelands.
 - The Washington Department of Fish and Wildlife’s (WDFW’s) Hydraulic Project Approval (HPA) process does not enforce HPA conditions nor are there feedback or comments on monitoring results (adaptive management on the HPA process seems limited).
- Response on stressors that cause eelgrass declines
 - invasive or non-native species (e.g., *Z. japonica*)
 - non-point source pollution
 - lack of regulation of nutrient inputs to Puget Sound
 - turbidity
 - sea-level rise
 - shoreline hardening and sediment starvation
 - shoreline and watershed development (upland development).

3.1.2 Shoreline Master Program Meetings

Two Shoreline Master Program meetings were held:

- October 2012 – An overview of the project was announced at the quarterly Shoreline Master Program meeting on October 25, 2012, in Tumwater, Washington. Although the meeting generated many contacts and provided an opportunity to distribute information about the project, little new information was collected from the audience that provided insight into stressors and regulatory barriers that affect eelgrass.
- January 2013 – An overview of the project was presented at the quarterly Shoreline Master Program meeting on January 24, 2013, in Tumwater, Washington. Audience members were given notecards with instructions to write down any areas they may know of where eelgrass grew historically but is now absent or declining, or any areas where if stressor abatement were to occur eelgrass would be enhanced. No feedback was received from the audience.

3.1.3 Professional Contacts

Additional information about historical eelgrass distribution, stressors, or regulatory barriers was gathered from colleagues during impromptu meetings or phone conversations. The responses included the following:

- It was mentioned that there are two holes along the Port Townsend waterfront that need to be filled with suitable sediment and then transplanted with eelgrass. Currently, the holes are too deep for the continuous eelgrass bed to colonize, thereby leaving large unvegetated areas in the continuous eelgrass beds.
- Areas along the Cherry Point shoreline have eelgrass but the beds are thin. It is not clear if these beds have always been this way and if restoration might be considered for this area.
- Colleagues at other consulting firms were less willing to divulge information about specific sites where eelgrass restoration should be considered.
- Colleagues concerned about herring spawn have inquired about the eelgrass distribution along Point Bolin, on Kitsap Peninsula.

3.1.4 Shoreline Residents

Although shoreline residents could have potentially provided an abundance of information about the historical distribution of eelgrass and stressors that were affecting eelgrass in areas familiar to them, the primary effort to contact these stakeholders was through the online survey. However, conversations with a few citizens provided the following information:

- Residents along Zangle Cove and Amsterdam Bay are eager for eelgrass to be restored in the nearshore.
- Residents along Battle Point, on Bainbridge Island, have observed a decline in eelgrass and inquired why and if anything could be done along this shoreline to recover the eelgrass.

3.2 Results of the Survey

The recipients of the survey and its associated questions and responses are described in the following sections.

3.2.1 Survey Recipients

The survey was sent out to over 1,000 recipients on February 20, 2014. Of those 1,000 invites, 147 people responded (14.7 % response rate). Recipients of the survey included individuals from Federal (National Oceanic and Atmospheric Administration [NOAA], U.S. Environmental Protection Agency [EPA], U.S. Fish and Wildlife Service [FWS], U.S. Army Corps of Engineers [USACE]), State (Department of Natural Resources [DNR], WDFW, Washington State Department of Transportation [WSDOT], Department of Ecology [Ecology]) and local governments (counties and cities) as well as tribes, universities, citizen groups, consultants, and shellfish growers that are connected to Puget Sound in some manner. A listserv for the *Zostera japonica* Science Forum was also used; it included several Washington State lawmakers from the Puget Sound region. A total of 67 of the 147 respondents shared their contact information. Respondents who left contact information fell into the same categories listed above and included EPA (2), NOAA (3), USACE (1), FWS (1), WSDOT (1), WDFW (5), DNR (5), Ecology (3), Puget Sound Partnership (1), tribes (4), county (1), consultants (6), shellfish growers (3), universities (4), citizen groups (2), and other (25). A complete summary of results, including all questions and answers, plus any additional information respondents added is available in Appendix D.

3.2.2 Questions 1 and 2

The first two questions were designed to gather information about the respondents such as their connection to and knowledge of eelgrass in Puget Sound.

1. What phrase best describes you and your relationship with Puget Sound? (Please check only one. For example, if you are a scientist who studies trees in the mountains but you live overlooking Puget Sound, you should select Shoreline Resident).
 - Academic professor/instructor
 - Beach Watcher volunteer
 - Marine biologist
 - Natural resource manager
 - Nearshore / estuarine scientist
 - Puget Sound advocate
 - Puget Sound resident (~ 1-3 miles of shore)
 - Resident - western WA state
 - Resident - eastern WA state
 - Scientist
 - Shoreline resident
 - Shoreline policy maker
 - Other:
2. Please select a category that best describes your knowledge of eelgrass, *Zostera marina*, in Puget Sound.

- Excellent – understand the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.
- Good – some understanding of the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.
- Fair – little understanding of the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.
- Poor – only know eelgrass is a marine plant that grows in Puget Sound.
- None – do not know what eelgrass is.
- Other:

Results from the first two questions showed that natural resource managers made up 24% of the respondents and nearshore/estuarine scientists and marine biologist made up 14 and 12 %, respectively (Figure 3.1). Therefore, 50% of the respondents were associated with some aspect of natural and marine resource management or science. The respondents who considered themselves to have an “excellent” or “good” understanding of the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it made up approximately 81% of the 147 total responses received (Figure 3.2).

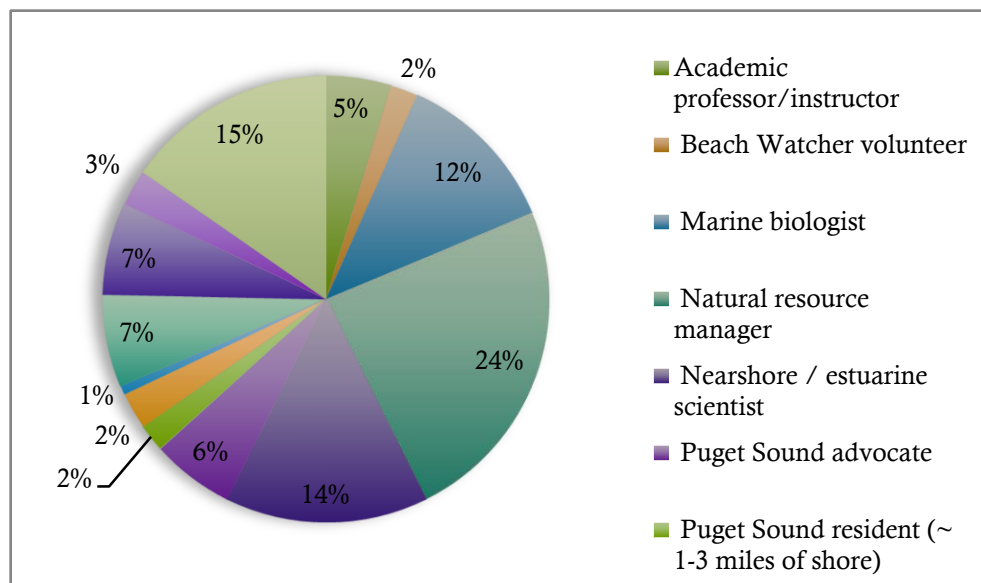


Figure 3.1. Description of survey respondent's relationship to Puget Sound (Question 1).

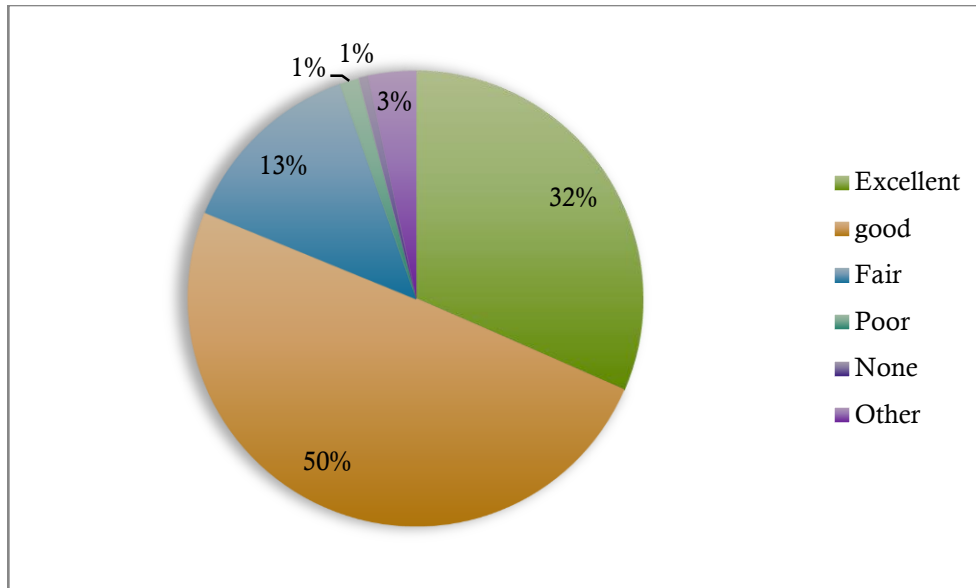


Figure 3.2. Description of survey respondent's knowledge of eelgrass in Puget Sound (Question 2).

3.2.3 Questions 3a – 3d

Respondents were asked to rank the effect of several stressors on eelgrass if they were to occur at a specific or discrete site in Puget Sound (3a) and in Puget Sound as a whole in its current state (3c). Both questions provided an opportunity for respondents to include comments (3b and 3d, respectively). A list of nine common stressors were ranked by the respondents and included anchoring, armoring, climate change, commercial aquaculture, dredging and filling, other marine vegetation, recreational resource harvest (e.g., clamming, fishing, crabbing), shoreline development, and water quality.

3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound. (0=no impact, 1=small impact, 2=medium impact, 3=large impact)

	Lack of research or data	NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2)	LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3)
Anchoring					
Armoring (seawalls & riprap)					
Climate change					
Commercial aquaculture					
Dredging & Filling					

	Lack of research or data	NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2)	LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3)
Other marine vegetation					
Recreational resource harvest (e.g., clamming, fishing, crabbing)					
Shoreline development					
Water quality					

Overall, the results indicate that four stressors were identified as having the largest impact on eelgrass when the stressor occurred in a specific location in Puget Sound. Dredging and filling, shoreline development, commercial aquaculture, and water quality were identified by survey respondents as having a large impact on eelgrass at discrete locations in Puget Sound (88, 50, 43, and 56% respectively; Figure 3.3).

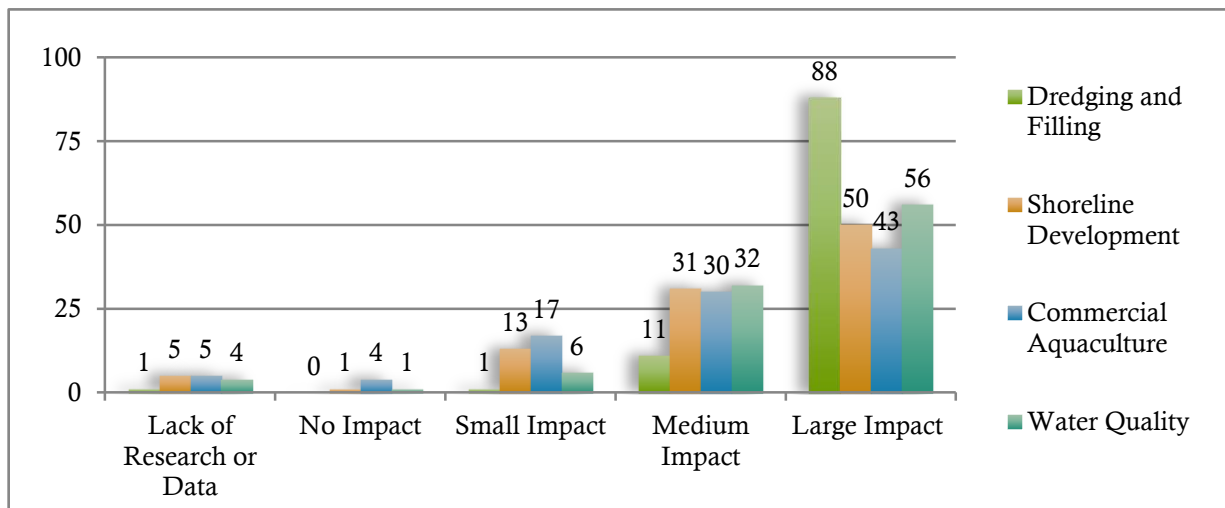


Figure 3.3. Percentage of respondents that indicated the effect of a particular stressor on eelgrass if it were to occur at a specific site in Puget Sound.

Anchoring, armoring, other marine vegetation, and climate change were identified by survey respondents as having a medium impact on eelgrass at a specific site in Puget Sound (35, 41, and 39% respectively), and climate change also had a large percentage of responses (26%) in the “lack of research” category (Figure 3.4).

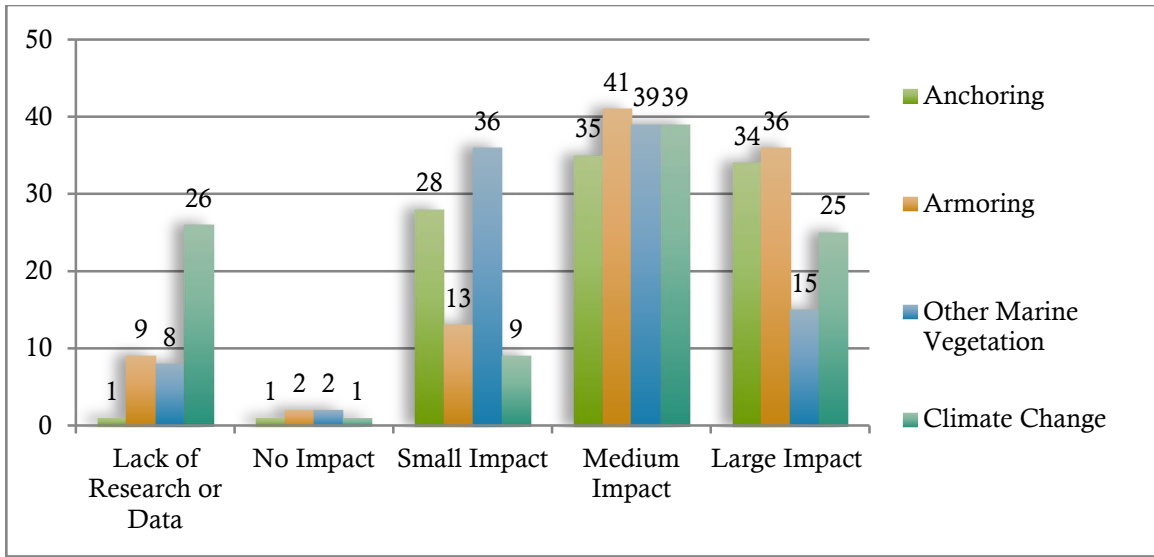


Figure 3.4. Percentage of respondents that indicated the effect of a particular stressor on eelgrass if it were to occur at a specific site in Puget Sound.

3b. Do you have any additional comments in regard to stressors that affect eelgrass at specific sites in Puget Sound?

Some respondents listed other stressors that were not included in the survey questions such as wood waste (in places such as Port Angeles and Port Gamble), reduced sediment inputs, and boat prop damage. Some respondents suggested that a stressor on its own may have a small impact but if it were combined with another stressor (or multiple stressors) it may have a large impact—in essence the compounding effect of multiple stressors can cause eelgrass decline.

3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state. (0=no impact, 1=small impact, 2=medium impact, 3=large impact)

	Lack of research or data	NO IMPACT to eelgrass in Puget Sound (0)	SMALL IMPACT to eelgrass in Puget Sound (1)	MEDIUM IMPACT to eelgrass in Puget Sound (2)	LARGE IMPACT to eelgrass in Puget Sound (3)
Anchoring					
Armoring (seawalls & riprap)					
Climate change					
Commercial aquaculture					
Dredging & Filling					
Other marine vegetation					

	Lack of research or data	NO IMPACT to eelgrass in Puget Sound (0)	SMALL IMPACT to eelgrass in Puget Sound (1)	MEDIUM IMPACT to eelgrass in Puget Sound (2)	LARGE IMPACT to eelgrass in Puget Sound (3)
Recreational resource harvest (e.g., clamming, fishing, crabbing)					
Shoreline development					
Water quality					

Dredging and filling, shoreline development, and water quality were also identified by survey respondents as having a large impact on eelgrass in Puget Sound as a whole at its current state (49, 44, and 43% respectively) (Figure 3.5).

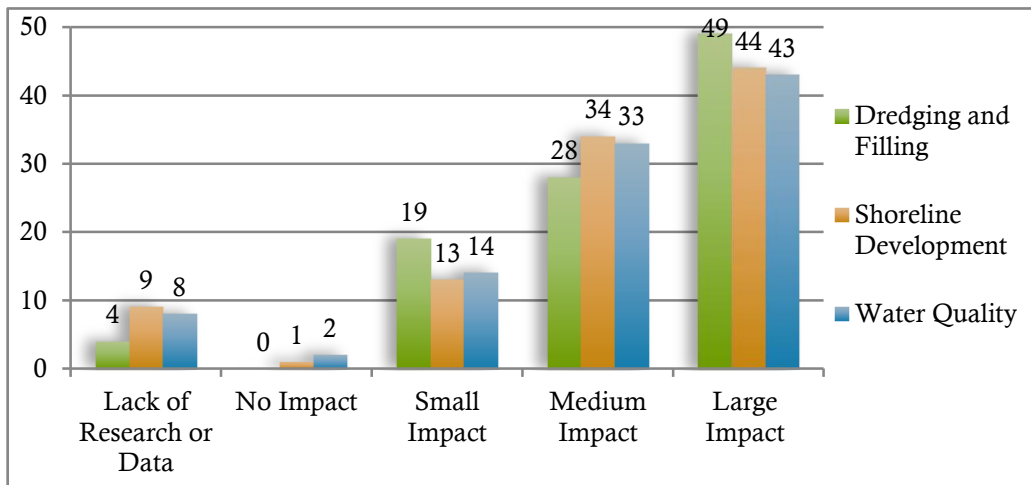


Figure 3.5. Percentage of respondents that indicated the effect of dredging and filling, shoreline development, and water quality on eelgrass if it were to occur in Puget Sound as a whole.

Respondents indicated that armoring and climate change have a medium impact on eelgrass in Puget Sound as a whole in its current state (40 and 26%, respectively), but a large percentage (28%) of respondents also indicated that there is a lack of research and/or data on the impacts of climate change on eelgrass (Figure 3.6).

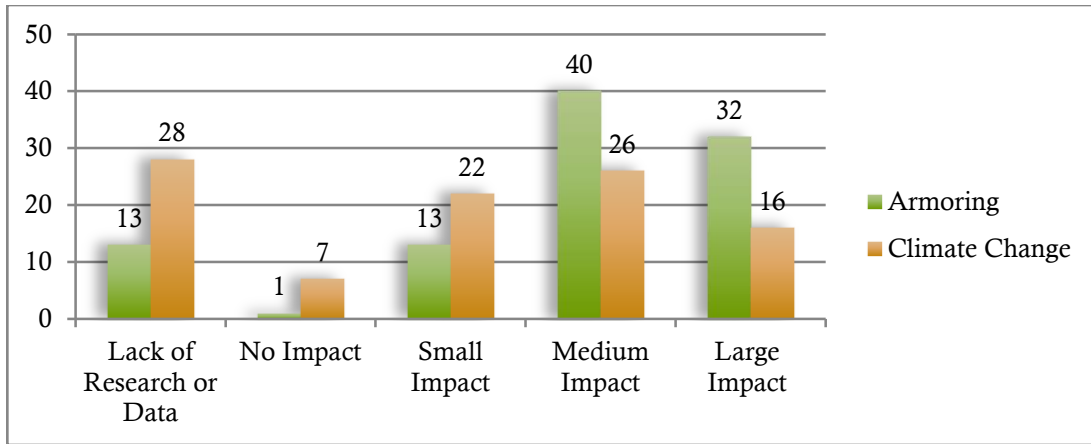


Figure 3.6. Percentage of respondents that indicated the effect of armoring and climate change on eelgrass if it were to occur in Puget Sound as a whole.

Respondents indicated that anchoring, commercial aquaculture, other marine vegetation, and recreational resource harvesting have a small impact on eelgrass in Puget Sound as a whole at its current state (40, 32, 46 and 52% respectively) (Figure 3.7).

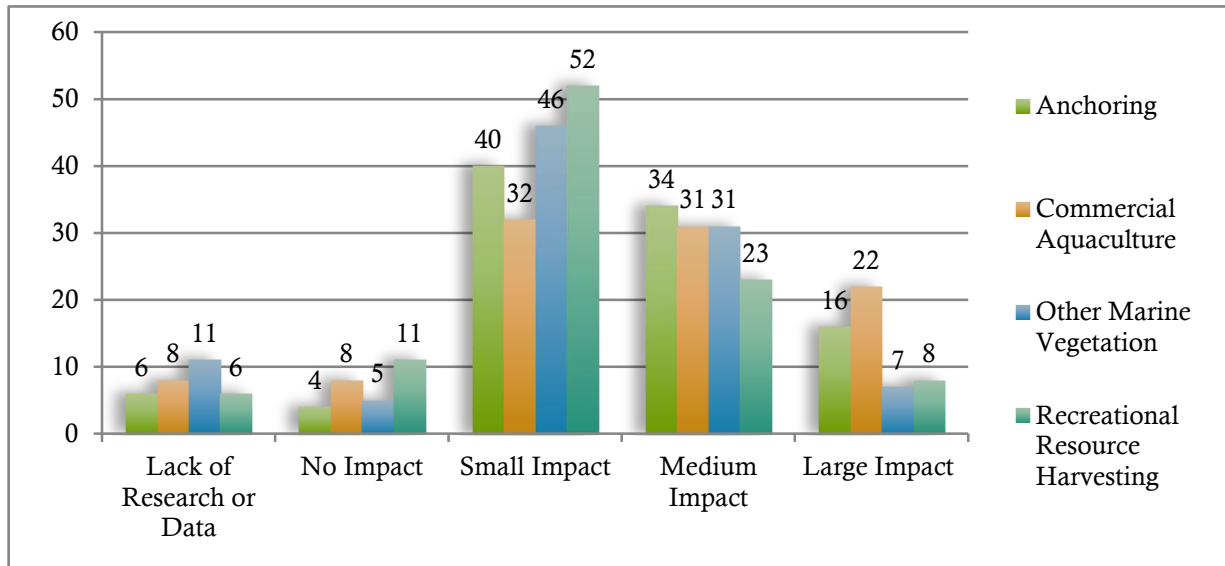


Figure 3.7. Percentage of respondents that indicated the effect of anchoring, commercial aquaculture, other marine vegetation and recreational resource harvest on eelgrass if it were to occur in Puget Sound as a whole.

3d. Do you have any additional comments in regard to stressors that affect eelgrass in Puget Sound?

Several respondents commented that overwater structures should have been identified as a stressor in a separate category. Many respondents also commented that although there are some data available about how stressors affect eelgrass, not enough is known to appropriately rank the stressors at this time. One respondent commented that potential impacts on eelgrass from the above-mentioned stressors would depend on the level (magnitude and frequency/duration) of the disturbance at any given location.

3.2.4 Questions 4a – 4c

Questions 4a – 4c inquired whether respondents thought certain policies were adequate in protecting eelgrass from direct impacts (e.g., dredging, overwater structures, mooring buoys), degrading environmental conditions (e.g., water quality, nutrient loading, and sediment loading), and project compliance requirements (e.g., mitigation ratios). If respondents indicated that certain policies would improve eelgrass protection for the examples provided, they were asked to provide information about the specific policies and location in Puget Sound.

- 4a. Will changing policies that protect eelgrass from direct impacts (e.g., dredging, overwater structures, mooring buoys) enhance eelgrass in Puget Sound?
- Yes
 - No

A majority of survey respondents (79%) indicated that changing policies that protect eelgrass from direct impacts would enhance eelgrass in Puget Sound. Respondents that answered “yes” were asked to explain their reasoning and provide an example of policies related to direct impacts that should be changed (Figure 3.8).

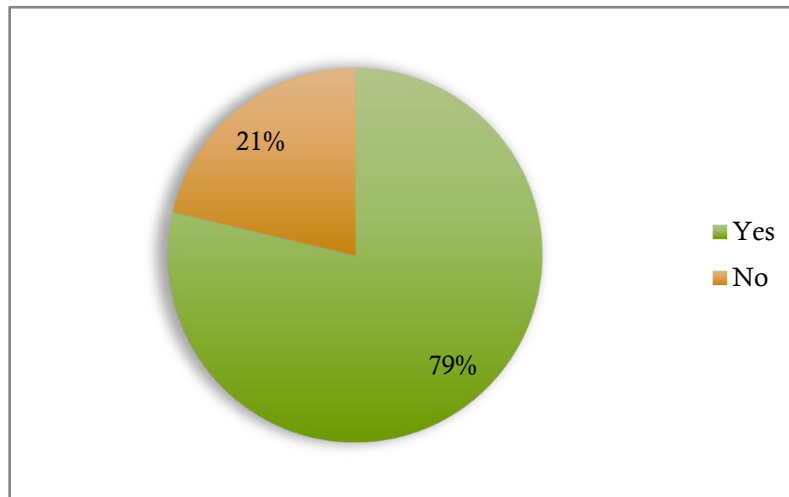


Figure 3.8. Percentage of respondents who think policies that protect eelgrass from direct impacts need to change.

If YES, please explain and provide an example of policies that need to be changed.

Respondents that felt current policies that protect eelgrass from direct impacts should change indicated that shoreline development and boat anchoring should be severely limited. Several comments from folks who felt existing laws that protect eelgrass from direct impacts are sufficient indicated that enforcement of such laws would substantially enhance eelgrass in Puget Sound.

- 4b. Will changing policies that protect eelgrass from degrading environmental conditions (e.g., poor water quality, nutrient loading, and sediment loading) enhance eelgrass in Puget Sound?
- Yes
 - No

A majority of survey respondents (90%) indicated that changing policies that protect eelgrass from degrading environmental conditions (e.g., poor water quality, nutrient loading, and sediment loading) would enhance eelgrass in Puget Sound (Figure 3.9). Respondents that answered “yes” were asked to explain their reasoning and provide an example of policies related to degraded environmental conditions.

If YES, please explain and provide an example of policies that need to be changed.

Some examples of changes in policies that protect eelgrass included increasing the mitigation ratios, limiting or eliminating dredging permits, and enhancing restrictions on property owners. Several respondents commented that enforcing current regulations alone would enhance and protect eelgrass in Puget Sound.

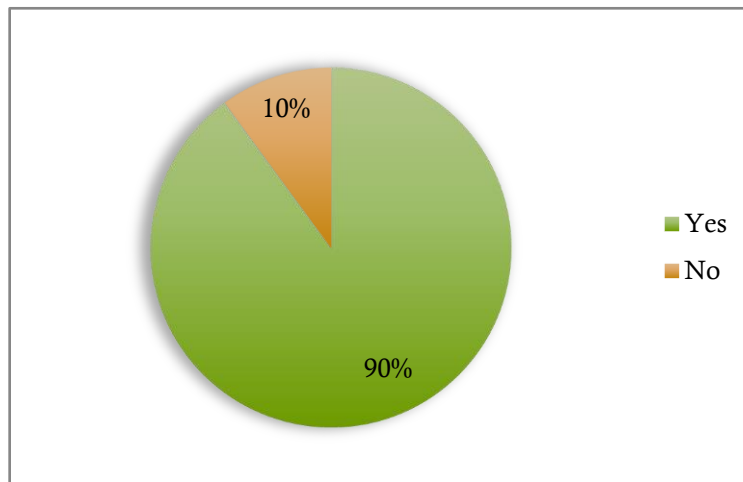


Figure 3.9. Percentage of respondents who think policies that protect eelgrass from environmental degradation need to change.

- 4c. Will changing policies that require greater project compliance (e.g., larger mitigation ratios, higher transplant success criteria, and longer monitoring periods) enhance eelgrass in Puget Sound?
- Yes
 - No

A majority of survey respondents (76%) indicated that changing policies that require greater project compliance (e.g., larger mitigation ratios, higher transplant success criteria, and longer monitoring periods) would enhance eelgrass in Puget Sound (Figure 3.10). Respondents that answered “yes” were asked to explain their reasoning and provide an example of policies related to greater project compliance.

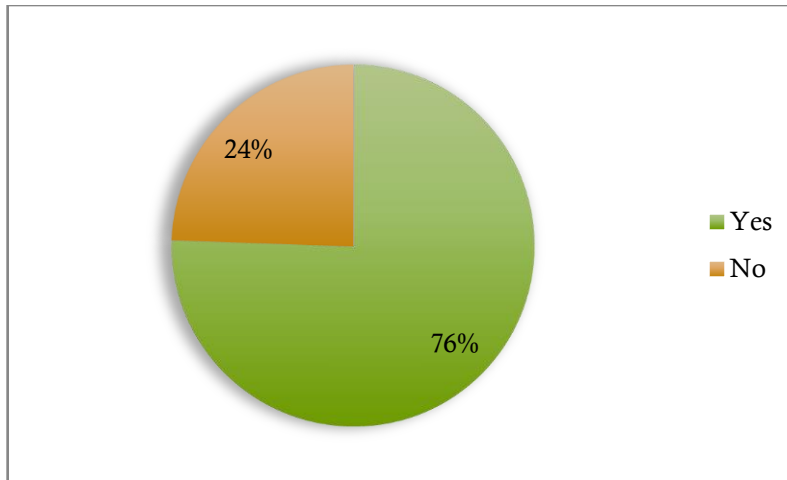


Figure 3.10. Number of respondents who think policies that require greater project compliance need to be strengthened.

If YES, please explain and provide an example of policies that need to be changed.

The general consensus in response to this question was that if the existing policies (e.g., no-net-loss policy) were more strictly enforced then there would be fewer overall impacts on eelgrass. To implement the no-net-loss policy properly, respondents recommended enforcing HPA policies, requiring greater project compliance, and demonstrating project follow-through by means of post-project evaluations and documentation of project success and reasons for failure. Some respondents suggested increasing mitigation ratio requirements and requiring project proponents to effectively demonstrate success to further encourage avoidance of eelgrass resources.

Although certain Washington State laws protect water-dependent uses, some proponents implied a change to give state and local jurisdictions the ability or empowerment to restrict activities to protect critical habitats or species, thereby preventing any activities that would directly affect eelgrass.

3.2.5 Questions 5a – 5e

Questions 5a-e asked respondents for information about specific locations in the greater Puget Sound, broken into five regions, where eelgrass once grew but is no longer found. The goal of these questions was to isolate specific areas within five different regions of Puget Sound where local knowledge might provide further model validation and site-specific recommendations where to transplant eelgrass.

5a-e. Do you know of any areas in greater Puget Sound (Neah Bay east and south of Pt. Roberts) where eelgrass once grew? If so, where and what in your view is preventing it from growing there now? Please share as much location information in the text box for each area below (location name, GPS coordinates, and any stressor-abatement activities that need to be performed prior to eelgrass transplantation).

5a. North Puget Sound and Strait of Juan de Fuca
(Neah Bay east and Pt. Roberts south to Admiralty Inlet)

5b. Saratoga – Whidbey Basin

(Deception Pass south to Possession Point-Mukilteo)

5c. Central Puget Sound
(Admiralty Inlet south to Tacoma Narrows)

5d. South Puget Sound
(Tacoma Narrows south)

5e. Hood Canal
(Port Ludlow area south to Lynch Cove)

Any additional information to improve eelgrass restoration and conservation in Puget Sound?

Contact information? (optional)

First Name

Last Name

Occupation

Email

Survey recipients were asked to provide details such as location name, Global Positioning System (GPS) coordinates, and any stressor-abatement activities that would need to be performed prior to eelgrass transplantation in several regions throughout Puget Sound, including North Puget Sound and Strait of Juan de Fuca, Saratoga – Whidbey Island, Central Puget Sound, South Puget Sound, and Hood Canal. Only one respondent included coordinates for a specific location in Similk Bay, in Skagit County (48.437249, -122.563657), where the areal extent of eelgrass has declined, possibly due to poor water quality caused primarily by runoff from Highway WA-20 (as suggested by the respondent). Several respondents proposed areas near Port Angeles and Port Gamble where wood waste from log booms prevent eelgrass from growing. Other reasons for eelgrass decline or its absence at the various locations were, as put forward by the survey respondents, due to recreational shellfish harvest within eelgrass meadows, vessel anchoring, boat traffic, increased sediment accretion, increased nutrient loading from septic systems, development near the shoreline, and competition from non-native species. Many respondents also cited areas where overwater structures were located (e.g., ferry terminals, docks, etc.) within several of the regions as areas where eelgrass could be transplanted if the stressor was abated.

All comments from survey respondents are in Appendix D. A brief summary of potential transplantation sites within the five regions is listed below:

- North Puget Sound and the Strait of Juan de Fuca – Ediz Hook, Westcott Bay, NE Blakely Island (San Juan County), Garrison Bay (San Juan Island), Dungeness Bay, Freshwater Bay, Cherry Point (Whatcom County), west side of Protection Island, Port Townsend, and Bellingham Bay.
- Saratoga/Whidbey Island – Amsterdam Bay, Holmes Harbor (near the southern end), Similk Bay, Port Susan, Mukilteo boat launch.
- Central Puget Sound – Dyes and Sinclair Inlets, Liberty Bay, Blake Island marina, and the Kingston ferry terminal and marina.

- South Puget Sound –Nisqually Estuary, and Zangle cove.
- Hood Canal – Port Gamble, Hoodsport, Anna’s Bay (south Hood Canal, adjacent to the Skokomish delta estuary), Quilcene Bay (along east shoreline), and Potlach and Twanoh State Parks.

4.0 Discussion

The survey response rate (14.7%) for this study was low compared to other email based surveys (25–30%, Kittleson 1997; 20%, Kaplowitz et al. 2004; 35–40%, Cook et al. 2000) and considerably lower than surveys that used other distribution methods (e.g., mail, postcard reminders or a mix of distribution methods such as mail, email, and postcard reminders; Cook et al. 2000; Dillman 2000; Shih and Fan 2008, 2009). We expected the importance of the survey topic (i.e., habitats, eelgrass, and Puget Sound), the length of the survey (five questions), and the simplicity of the response submittal process would have increased the overall response rate. Although we did not have mailing addresses for the survey recipients, a follow-up email reminding them to complete the survey may have increased response rates. It has been shown in other surveys that pre- and post-notification has increased survey response rates (Cook et al. 2000; Fox et al. 1988; and Heberlein and Baumgartner 1978).

Of the survey respondents, 47% claimed to have close ties to Puget Sound, whether they described themselves as a Beach Watcher volunteer, marine biologist, nearshore/estuarine scientist, Puget Sound resident or advocate, shoreline resident, or shoreline policy maker. Although the remaining 53% may have keen interests in the health and productivity of Puget Sound, these respondents identified themselves as academic professors and instructors, natural resource managers, residents in eastern and western Washington State, scientists, or as “Other” (15% of the 53%). Even so, most of the respondents (82%) claimed to have good knowledge of eelgrass or better; a third (32%) of the respondents claimed to have excellent knowledge of eelgrass and 50% claimed to have good knowledge of eelgrass.

4.1 Eelgrass Stressors

The survey results showed that respondents considered the stressor with the largest impact on eelgrass at specific sites to be dredging and filling. Water quality, developed shorelines, and commercial aquaculture (in that order) were also ranked high as stressors that would affect eelgrass at a specific site. These results were similar to an earlier analysis of stressors in Puget Sound that found the order of the top five threats to eelgrass were 1) sea-level rise, 2) dredging and filling, sea temperature rise, and overwater structures, 3) suspended sediments, 4) nutrients, and 5) aquaculture (Thom et al. 2011). Surprisingly, survey respondents ranked climate change (e.g., sea-level rise and sea temperature rise) low as major impacts on eelgrass at specific sites in Puget Sound (25%) and even lower as a major threat to eelgrass in Puget Sound at its current state (15%). However, given the recent attention to climate change since completion of the survey (e.g., ice sheet calving in Antarctica, global emissions from coal-fired power plants), results may differ if a subsequent survey were conducted.

The manner in which a stressor affects eelgrass varies spatially and temporally throughout Puget Sound. For example, a boat anchor will affect an area roughly the size of the anchor plus any scour associated with setting and hauling the anchor and scour from the chain as the boat swings on its mooring. Although the impact could result in complete scour of an area, a single anchoring event tends to affect a small area and the eelgrass could recover over time providing minimal confounding effects from other stressors. The effects of climate change could be slower to observe but much more damaging and irreversible in the near term.

To reduce the survey length, only nine stressors, considered to have detrimental effects to seagrass globally and eelgrass locally (Thom et al. 2011), were included in the ranking process for questions 3 and

4. As expected, the survey response for certain stressors varied between site-specific effects on eelgrass (question 3) or Sound-wide effects on eelgrass (question 4). More than a third (34%) of respondents considered anchoring to have large impacts on eelgrass at specific sites but only 16% considered this stressor to have large impacts on eelgrass in Puget Sound as a whole. Similar results were observed when ranking the effects of commercial aquaculture, marine vegetation, and dredging and filling. The survey respondents indicated dredging and filling had a large impact on eelgrass at specific sites in the Sound (88%) and throughout Puget Sound in its current state (49%). These findings are consistent with global seagrass habitat loss where large expanses of seagrass have been lost due to dredge-and-fill activities (Short and Wyllie-Echeverria 1996; Park et al. 2009). There is even local evidence of the effects of dredge-and-fill activities and the loss of eelgrass habitat (Thom and Hallum 1991).

Interestingly, the four stressors (anchoring, commercial aquaculture, marine vegetation, and dredging and filling) that received the highest number of “large impact to eelgrass” responses tend to cause a quick and observable change. In the case of dredging and filling or anchoring activities the result in eelgrass habitat is typically an unvegetated, bare substratum, whereas, aquaculture activities or other marine vegetation typically replace the eelgrass with other marine flora (i.e., non-native species such as *Sargassum*) or cultured shellfish.

The stressor rankings that did not vary much between the site-specific and Sound-wide spatial scales were armoring, climate change, recreational resource harvesting, shoreline development, and water quality. Shoreline development and water-quality effects on eelgrass were closely ranked in the category of “large impact to eelgrass at a specific site”; 50% and 56% of the responses, respectively, indicated that shoreline development and water quality have large effects on eelgrass in Puget Sound. At the Sound-wide scale, 44% and 43% of the responses indicated that shoreline development and water quality, respectively, have large impacts on eelgrass in Puget Sound.

An interesting pattern was observed with the responses to armoring and climate change where there has been a limited amount of research conducted to identify the effects of these stressors on eelgrass in Puget Sound (Rehr et al. 2014; Thom et al. 2011). Most respondents identified both stressors as having a medium impact on eelgrass at specific sites and throughout Puget Sound, and this may have been a result of the fact that respondents knew there has been limited research on these topics. The respondent feedback in the “lack of research” category for armoring and climate change was highest compared to all other stressors, 9–13% and 26–28%, respectively. It is hypothesized that shoreline armoring has negative effects on nearshore processes and seagrass beds but there is limited research on this relationship (Rehr et al. 2014; Thom et al. 2011). Recently, a few research programs have been investigating the distribution of submerged aquatic vegetation related to hardened and natural shorelines within the mid-Atlantic region of the United States (Landry et al. 2013; Patrick and Weller 2013).

4.2 Respondents’ Feedback to Stressor Ranking

The comments from respondents for the two stressor ranking questions (questions 3a and 3c) were quite valuable, particularly relative to how to design a subsequent survey. The most repeated feedback from respondents included the following:

- There were a number of cases where respondents wanted to break down the general stressor categories into more detailed stressors or add a stressor. The reason for this was some stressors

affected eelgrass differently or there was just more information available about particular stressors. Some examples included:

- anchoring – anchor types (e.g., helical, mushroom, concrete block) and the intensity of anchoring compared to mooring fields
 - armoring – location and type of armoring relative to mean lower low water
 - commercial aquaculture – type (e.g., finfish pens, oyster, geoducks, Manila clams), aquaculture intensity, and location of aquaculture
 - boat activity (e.g., propeller wash and boat traffic)
 - nutrient and sediment loading.
- The survey did not include an option to rank overwater structures. Although it was assumed that overwater structures were considered shoreline development, varying types of shoreline development affect eelgrass differently. For example, upland development could affect eelgrass indirectly (e.g., increase stormwater runoff adding to the reduction in available light), whereas a pier could have both direct (e.g., construction) and indirect (e.g., reduction in available light) effects on eelgrass. Respondents repeatedly raised the concern that there was no ranking for overwater structures in the survey. Also, log rafts should have been incorporated into the survey as an overwater structure that could have dire impacts on eelgrass habitat.
 - It was not clear how the survey would weigh survey responses relative to the knowledge base of a respondent. Some respondents thought answers from a person with lots of knowledge should be weighted more than responses from a person with little knowledge who is just checking boxes in the survey.
 - Respondents had difficulty ranking stressors due to the lack of site specificity, intensity of stressors, and the lack of a temporal scale.
 - Respondents acknowledged the lack of research or understanding of how certain stressors (e.g., armoring, climate change, and some other stressors) would affect eelgrass.

Many of the issues addressed by the respondents were not incorporated in the survey in an effort to keep the survey short and succinct. It may be worthwhile to consider incorporating more detail in subsequent surveys, but doing so would require the survey to be restructured, considerably longer, and a bit more complicated. The result of a longer and more complicated survey may be a lower response rate.

4.3 Policies that Protect Eelgrass

The goals of the policy questions were to determine whether existing policies that regulate activities in Puget Sound were adequate to protect eelgrass. More than 75% of the respondents answered “yes” that policy changes would further protect eelgrass from direct impacts (4a), environmental degradation (4b), and the lack of project compliance. The follow-up questions to questions 4a–4c were designed to learn more about specific policies related to activities that directly damage eelgrass, degrade environmental quality, and compromise regulatory compliance that need to be changed to improve the protection of eelgrass in Puget Sound. Although a few respondents referred to specific regulations, most of the responses to questions 4a–4c provided examples of activities that need to be changed or to be strictly regulated to better protect eelgrass in Puget Sound (Appendix D).

The overriding themes in respondents' answers to the follow-up question to questions 4a–4c included the following:

- 4a – Policies related to direct impacts
 - Require and enforce stricter regulations and improve policies to provide better project oversight and compliance that will protect eelgrass. Basically, enforce the no-net-loss policy by avoiding impacts on eelgrass at all costs.
 - Prohibit activities that affect critical habitat such as eelgrass and even potential habitat where eelgrass could colonize. Examples of activities include anchoring, aquaculture, dredging, and construction (e.g., overwater structures, seawalls).
- 4b – Policies related to degrading environmental conditions
 - Increase and enforce regulations on discharges into Puget Sound. Discharges include primarily stormwater, sewage discharges, and National Pollution Discharge Elimination System-permitted (NPDES) outfalls that add nutrients, sediments, and in some cases, known and unknown toxic contaminants (e.g., chemicals of emerging concern, personal care products, pesticides, and herbicides).
 - Increase and enforce regulations that affect the natural environment throughout Puget Sound.
 - Improve watershed management practices to reduce nutrient, sediment, and contaminant loading.
- 4c – Policies related to greater project compliance
 - Develop and provide resources for a comprehensive science and management team to revise existing policies that support eelgrass conservation and protection (e.g., ability to adaptively manage).
 - Modify and enforce mitigation requirements to include larger mitigation ratios, demonstrated pre-mitigation success, and in-lieu fees if mitigation fails. In addition, mitigation procedures should require higher transplant success ratios and considerably longer monitoring periods (5–10 years).

4.4 Site Recommendations

Questions 5a-e inquired about areas in Puget Sound where eelgrass once grew and what activity or stressor caused it to disappear. Respondents had an opportunity to provide answers in a general sense and then provide more specific areas in each subsection of the question (Appendix D).

The survey and expert solicitation identified 29 sites throughout the five regions of Puget Sound that were recommended for further investigation as potential eelgrass restoration sites (Table 4.1). In addition, the solicitation identified 12 sites where a focus on stressor abatement would make a site more suitable for eelgrass restoration in the future (Table 4.1).

Table 4.1. Sites recommended for eelgrass restoration or stressor abatement in the five Puget Sound regions as a result of the survey and expert solicitation. The Model Validation column indicates whether the site aligns with the model output as a suitable eelgrass restoration site (– = poor alignment, + = good alignment).

Region	Location	Action (eelgrass restoration or stressor abatement)	Model Validation (-, +)
North Puget Sound & Strait of Juan de Fuca	Freshwater Bay		+
	Ediz Hook	Stressor abatement first (wood waste removal) then eelgrass restoration	+
	Dungeness Bay		+
	Protection Island – west side		+
	Bellingham Bay	Stressor abatement first then eelgrass restoration	–
	Garrison Bay		+
	NE Blakely Island	Stressor abatement first (removal of sandy deposit from a land slide) then eelgrass restoration	–
	Westcott Bay	Stressor abatement first (anchoring) then eelgrass restoration, enforcement of “no anchor” zone requirements	+
	Cherry Point		+, –
	Saratoga – Whidbey Basin	Holmes Harbor (southern end)	Stressor abatement first (impacts from boat construction business) then eelgrass restoration
Similk Bay		Stressor abatement first (excess nutrient runoff from golf course and failed septic systems) then eelgrass restoration	–
Port Susan			–
Mukilteo boat launch			–
Central Puget Sound	Dyes and Sinclair Inlets		+
	Liberty Bay		+
	Blake Island marina	Stressor abatement first (overwater structures) then eelgrass restoration	+
	Nearshore divots in Port Townsend	Stressor abatement first (anchoring) then eelgrass restoration	+, –
	Battle Point, Bainbridge		+
	Point Bolin, Kitsap		+, –
	Kingston ferry terminal and marina	Stressor abatement first (overwater structures) then eelgrass restoration	+

Table 4.1. (contd)

Region	Location	Action (eelgrass restoration or stressor abatement)	Model Validation (-, +)
South Puget Sound	Nisqually Estuary	Stressor abatement first (water-quality issues and over-active geoduck harvest) then eelgrass restoration	+
	Zangle cove	Stressor abatement first (water-quality issues) then eelgrass restoration	+
Hood Canal	Port Gamble	Stressor abatement first (wood waste removal and removal of overwater structures) then eelgrass restoration	+
	Hoodsport		+, -
	Anna's Bay (south Hood Canal, adjacent to the Skokomish delta estuary)		-
	Quilcene Bay (along east shoreline)		-
	Lynch Cove		-
	Potlach State Park Twanoh State Park		-

The breakdown of the potential restoration sites on a per region basis found most of the sites were located in the North Puget Sound and Strait of Juan de Fuca region (Table 4.2). The region with the second highest number of sites recommended for restoration was Hood Canal, however, only two of these sites match the model output as suitable for eelgrass restoration (Table 4.2).

Table 4.2. Number of sites recommended for eelgrass restoration or stressor abatement for the five Puget Sound regions as a result of the survey and expert solicitation. The Sites with Positive Model Validation column indicates the number of sites that positively align with the model output as a suitable eelgrass restoration site (see Table 4.1).

Region	Total Sites Recommended	Sites with Positive Model Validation	Number of Sites Requiring Stressor Abatement
North Puget Sound & Strait of Juan de Fuca	10	8	5
Saratoga–Whidbey Basin	4	1	2
Central Puget Sound	6	6	2
South Puget Sound	2	2	2
Hood Canal	7	2	1

5.0 Conclusions and Recommendations

In an effort to achieve the recovery target of 20% more eelgrass in Puget Sound by 2020, an eelgrass (*Zostera marina* L.) transplant suitability model was developed to identify suitable eelgrass transplant sites with the intention of optimizing where transplant success would most likely be optimized. As with any model, the performance and output is generally confined by the availability of quality data. Under circumstances where there is limited data are limited other approaches can be employed used to improve model performance or to further filter model results. For this task, input from stakeholders was solicited through a range of media to acquire additional information about eelgrass stressors, potential restoration sites, and regulations that would improve eelgrass conservation and protection. The stakeholder input that provided specific eelgrass information, such as sites where eelgrass historically grew or locations with visible stressors affecting eelgrass, will be used to filter model outputs to improve restoration efforts.

The survey also solicited additional input about specific stressors that stakeholders identified as having the greatest effect on eelgrass in Puget Sound and policies related to direct impacts, degrading environmental conditions, and project compliance. Respondents believe that dredging and filling and commercial aquaculture have the greatest potential to affect eelgrass at specific sites throughout Puget Sound. Whereas water quality, shoreline development, and dredging and filling all seem to have the greatest potential impact on eelgrass throughout Puget Sound in its current state. Based on these results, careful consideration in conserving and protecting critical habitats must be taken as developmental pressures increase within the region. The population living near Puget Sound is projected to increase by more than a million people by 2025 (http://www.psparchives.com/puget_sound.htm, <http://www.ofm.wa.gov/pop/default.asp>). This growth in population will result in an increase in the built environment, which will raise the potential for degraded water quality and an increase need for local and global food production, potentially increasing pressures from the expansion of commercial aquaculture in the region. Planning for these changes throughout Puget Sound will need to consider approaches that have minimal environmental impacts to protect and conserve eelgrass and other important marine resources.

Survey respondents were quite aware of the need to protect eelgrass through policies that minimize both direct and indirect impacts on the resource (i.e., dredging/filling and water quality). It was also evident that enforcement of existing and new policies will help protect and conserve eelgrass. However, securing the resources necessary to support compliance will be a difficult challenge if eelgrass is to be protected.

Transplanting eelgrass alone will not achieve the goal of increasing the overall acreage extent of eelgrass in Puget Sound. Changing existing policies to better protect eelgrass from direct impacts and degrading environmental conditions, as well as increasing the enforcement of project compliance will be critical for this effort. It is important to identify and abate the effects of stressors affecting eelgrass and to ensure long-term viability of the effort to increase eelgrass in Puget Sound, whether it involves restoration, conservation, protection, or a combination of all three actions.

The model produced a range of sites throughout Puget Sound where eelgrass transplantation would be successful based on the availability of environmental data. Although a substantial amount of environmental data is available to populate the model, further refinement and additional information to filter model outputs will continue to be important for optimizing eelgrass transplant success. In addition

to the model output, further refinement of potential eelgrass test transplant sites was conducted using filters based on the data collected during impromptu meetings with stakeholders, at conferences, and through the online survey. Additional data, such as eelgrass presence or absence, will be included to refine the site selection process, but other information could be useful to further refine the model, eelgrass transplant site selection, and transplant success. Additional data solicited through meetings, discussions, and the survey included information about eelgrass distribution, speculative causes for eelgrass decline in an area, and current site-specific stressors. Based on these data and the model output certain sites were identified as potential future test transplant sites (Table 5.1).

Table 5.1. Recommended sites for future eelgrass test transplantation based on model output and stakeholder solicitation. Some sites will require stressor abatement to have successful eelgrass transplantation (e.g., Port Townsend Bay, Westcott Bay)

Region	Site Location
North Puget Sound & Strait of Juan de Fuca	Westcott Bay
Saratoga–Whidbey Basin	Holmes Harbor
Central Puget Sound	Port Townsend Bay
South Puget Sound	Zangle Cove Nisqually Delta
Hood Canal	Port Gamble

The acquisition of supplementary data, as described under this task, will support eelgrass transplant site selection prioritization, enhance eelgrass transplant success, and improve the protection and conservation of eelgrass resources in Puget Sound.

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Appendix A

Data Sources Solicited to Refine Eelgrass Test Transplant Site Selection Model

Appendix A

Data Sources Solicited to Refine Eelgrass Test Transplant Site Selection

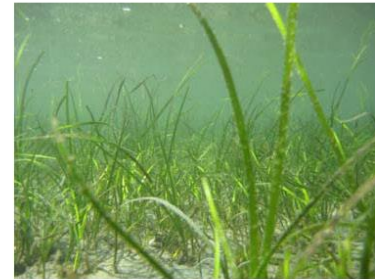
- A. Shoreline Master Program managers (Peter Skowlund) – We attended the Shoreline Master Program planning meeting in January 2013 and presented an overview of the eelgrass site selection tool being developed and the application of identifying suitable eelgrass transplantation sites in management areas throughout the Sound. We also distributed note cards to the audience to give them a chance to provide input regarding local eelgrass knowledge (where it grows, where it used to grow, why it disappeared, what needs to be done to better protect or conserve eelgrass in their area of interest). In addition, we solicited the audience to learn about other tools they could use to better protect eelgrass in their jurisdictions; however, we did not get any responses.
- B. Northwest Straits Commission and Marine resource committees (MRCs)
 - 1. Island County
 - 2. Whatcom County
 - 3. Jefferson County
 - 4. Snohomish County
 - 5. Skagit County
 - 6. San Juan County
 - 7. Clallam County
- C. Northwest Indian Fisheries Commission (NIFC)
 - 1. Identify a contact at NIFC and see if we can present or distribute a project overview to them.
- D. Community members, citizens
 - 1. Washington State University Beach Watchers Program
 - 2. Adopted the Submerged Vegetation Monitoring Program (SVMP) methodology and applied it to sites throughout Saratoga – Whidbey Sound.
- E. Scientists
 - 1. University of Washington (Friday Harbor Laboratory – Sandy Wyllie-Echeverria, Si Simenstad)
 - 2. Seattle Pacific University (Tim Nelson)
 - 3. Western Washington (Shannon Point – Sylvia Yang)
 - 4. Walla Walla University (Rosaria Beach Marine Station)
- F. Consultants
 - 1. Solicit information from consultants in our study area.
 - a. Pentec – HartCrowser

- b. JenJay, Inc.
 - c. Research Support Services (RSS – http://www.rssincorporated.com/Research_Support_Services/HOME.html)
 - d. BioAquatics International (Dan Cheney - <http://www.pacshell.org/staff/cheney.htm>)
- G. Historical documents, reports, charts, records
- 1. Thom and Hallum (1990 and 1991)
 - 2. Washington Department of Fish and Wildlife – Hydraulic Project Approvals (HPA)
 - 3. Washington Department of Natural Resources
 - a. SVMP – source of eelgrass distribution and abundance data (2000-2012)
 - b. ShoreZone – eelgrass presence data source (1994-2000)
 - c. CASI data – limited coverage
 - i. Whatcom County
 - ii. Skagit County
 - 4. PS Environmental Atlas (PSEA) – general overview of eelgrass distribution throughout Puget Sound (1987)
 - 5. Eelgrass Atlas Project – integrate eelgrass data from a range of sources in Puget Sound into one interactive, geospatial database. Project will be completed by June 30, 2013.

Appendix B

Poster

This poster was displayed at the 2012 annual meeting of the Pacific Estuarine Research Society to enable meeting participants to contribute additional information about eelgrass distribution in Puget Sound.



WE NEED 20% MORE EELGRASS

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ABSTRACT

Seagrasses have been declining to a point where it has been deemed a worldwide crisis. In response to regional and global needs, the Puget Sound Partnership's Action Agenda specifically targets an increase of 20% more eelgrass (*Zostera marina* L.) by 2020. Restoring eelgrass will benefit a multitude of species valued in Puget Sound, as well as contribute to water quality improvement, shoreline stabilization, and carbon sequestration. Because of its importance to nearshore food webs and shoreline processes, restoring eelgrass has been a general recommendation made by numerous entities for the entire Salish Sea. To accomplish this, the Marine Sciences Laboratory of the Pacific Northwest National Laboratory in partnership with the Washington Department of Natural Resources will employ numerical and spatial models, field studies, and test plantings to identify areas within Puget Sound that have a high probability of restoration success and resilience to natural and anthropogenic disturbances. Additional prioritization will be assigned for sites that would be conserved and protected through shoreline management actions.

In this poster, we seek your input on three different types of information and request that you **WRITE** your input directly onto this poster or otherwise express your comments to us.



WHERE?

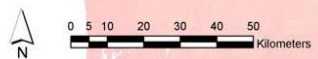
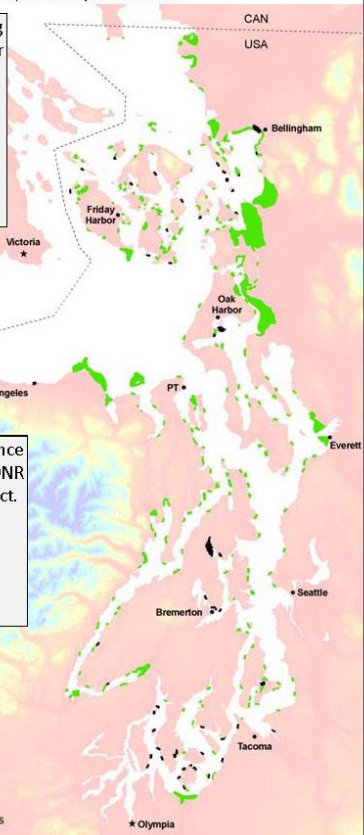
Are you aware of any location in Puget Sound where eelgrass used to grow, is still growing but appears under duress, has disappeared, or could potentially be restored?

Please add data to the map by drawing a polygon with the proper color marker where you have observed

- 1) Eelgrass growing – GREEN
- 2) Eelgrass loss – RED
- 3) Eelgrass restoration site – BLUE

Polygons in map show eelgrass presence and absence data from the WA DNR Submerged Vegetation Monitoring Project.

-  Eelgrass present
-  Eelgrass absent



HOW?

What barriers exist in local and regional regulations that could improve the stewardship, protection, and restoration of eelgrass in Puget Sound?

- Are regulations adequate to protect eelgrass?
- Are regulations consistently enforced?
- What data or tools are needed to better protect and restore eelgrass?

Please add your comments here.

STRESSORS?

What stressors do you believe caused or is currently causing eelgrass decline in Puget Sound?

- Are there particular stressors that are specific to an area or region of Puget Sound?

Please add your comments here.

Appendix C

Survey

Appendix C

Survey

The other method in which information will be acquired is through an online survey form (e.g., [Google forms](#)). [The survey introduction and questions are listed below.](#)

C.1 Eelgrass Transplant Suitability Project Survey

Eelgrass, *Zostera marina*, is the most abundant seagrass in Puget Sound, but there is evidence that natural and anthropogenic stressors are causing declines in the area and distribution of eelgrass.

In an attempt to restore eelgrass in Puget Sound, modeling and field studies are being conducted to identify suitable eelgrass transplant sites. However there is a need for additional information on management actions, stressor abatement and sites where eelgrass previously grew to improve eelgrass transplant success. The survey below is designed to get your perspective on these issues and should only take 5 – 10 minutes of your time. My apologies if you have received multiple survey requests. Only one response is necessary.

Please feel free to email me directly if you have any questions or if there is any additional information you would like to share with us to improve eelgrass transplant site suitability in Puget Sound. Thank you in advance for the time you will commit to complete the survey.

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1. What phrase best describes you and your relationship with Puget Sound? (Please check only one. For example, if you are a scientist who studies trees in the mountains but you live overlooking Puget Sound, you should select Shoreline Resident).

- Academic professor/instructor
- Beach Watcher volunteer
- Marine biologist
- Natural resource manager
- Nearshore / estuarine scientist
- Puget Sound advocate
- Puget Sound resident (~ 1-3 miles of shore)
- Resident - western WA state
- Resident - eastern WA state
- Scientist
- Shoreline resident
- Shoreline policy maker
- Other:

2. Please select a category that best describes your knowledge of eelgrass, *Zostera marina*, in Puget Sound.

- Excellent – understand the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.
- Good – some understanding of the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.
- Fair – little understanding of the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.
- Poor – only know eelgrass is a marine plant that grows in Puget Sound.
- None – do not know what eelgrass is.
- Other:

3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.

(0=no impact, 1=small impact, 2=medium impact, 3=large impact)

	NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2)	LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3)
Lack of research or data				
Anchoring				
Armoring (seawalls & riprap)				
Climate change				
Commercial aquaculture				
Dredging & Filling				
Other marine vegetation				
Recreational resource harvest (e.g., clamming, fishing, crabbing)				
Shoreline development				
Water quality				

3b. Do you have any additional comments in regard to stressors that affect eelgrass at specific sites in Puget Sound?

3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state. (0=no impact, 1=small impact, 2=medium impact, 3=large impact)

	Lack of research or data	NO IMPACT to eelgrass in Puget Sound (0)	SMALL IMPACT to eelgrass in Puget Sound (1)	MEDIUM IMPACT to eelgrass in Puget Sound (2)	LARGE IMPACT to eelgrass in Puget Sound (3)
Anchoring					
Armoring (seawalls & riprap)					
Climate change					
Commercial aquaculture					
Dredging & Filling					
Other marine vegetation					
Recreational resource harvest (e.g., clamming, fishing, crabbing)					
Shoreline development					
Water quality					

3d. Do you have any additional comments in regard to stressors that affect eelgrass in Puget Sound?

4a. Will changing policies that protect eelgrass from direct impacts (e.g., dredging, overwater structures, mooring buoys) enhance eelgrass in Puget Sound?

- Yes
- No

If YES, please explain and provide an example of policies that need to be changed.

4b. Will changing policies that protect eelgrass from degrading environmental conditions (e.g., poor water quality, nutrient loading, and sediment loading) enhance eelgrass in Puget Sound?

- Yes

- No

If YES, please explain and provide an example of policies that need to be changed.

4c. Will changing policies that require greater project compliance (e.g., larger mitigation ratios, higher transplant success criteria, and longer monitoring periods) enhance eelgrass in Puget Sound?

- Yes
- No

If YES, please explain and provide an example of policies that need to be changed.

5a-e. Do you know of any areas in greater Puget Sound (Neah Bay east and south of Pt. Roberts) where eelgrass once grew? If so, where and what in your view is preventing it from growing there now? Please share as much location information in the text box for each area below (location name, GPS coordinates and any stressor-abatement activities that need to be performed prior to eelgrass transplantation).

5a. North PS and Strait of Juan de Fuca
(Neah Bay east and Pt. Roberts south to Admiralty Inlet)

5b. Saratoga - Whidbey Basin
(Deception Pass south to Possession Point-Mukilteo)

5c. Central Puget Sound
(Admiralty Inlet south to Tacoma Narrows)

5d. South Puget Sound
(Tacoma Narrows south)

5e. Hood Canal
(Port Ludlow area south to Lynch Cove)

Any additional information to improve eelgrass restoration and conservation in PS?

Contact information? (optional)

First Name

Last Name

Occupation

Email

Appendix D
Survey Responses

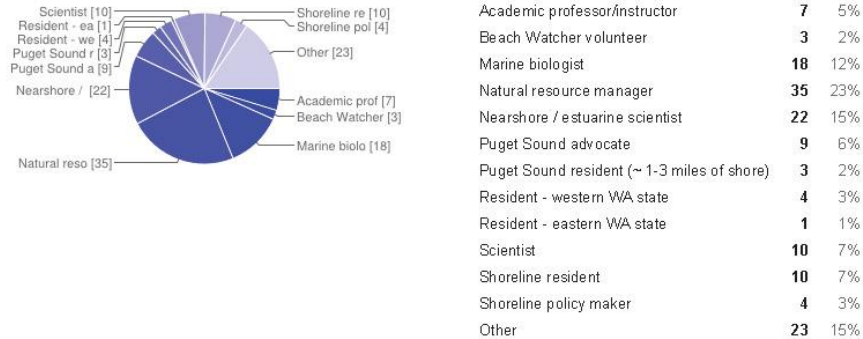


149 responses

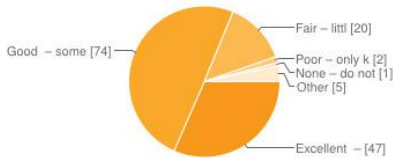
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Summary

1. What phrase best describes you and your relationship with Puget Sound? (please check only one)

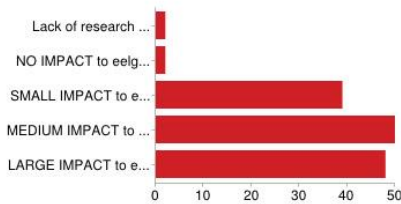


2. Please select a category that best describes your knowledge of eelgrass, Zostera marina, in Puget Sound.



Excellent – understand the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.	47	32%
Good – some understanding of the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.	74	50%
Fair – little understanding of the functions and values of eelgrass, its abundance and distribution throughout Puget Sound, and the stressors that affect it.	20	13%
Poor – only know eelgrass is a marine plant that grows in Puget Sound.	2	1%
None – do not know what eelgrass is.	1	1%
Other	5	3%

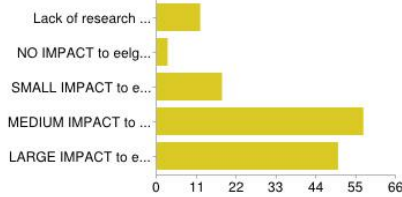
Anchoring [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



Lack of research or data	2	1%
NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	2	1%
SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	39	26%

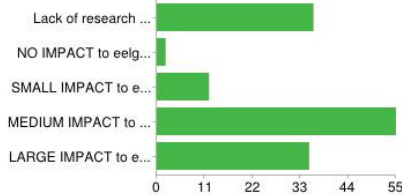
MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2) **50** 35%
 LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3) **48** 34%

Armoring (seawalls & riprap) [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



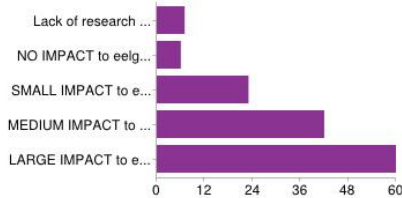
Lack of research or data **12** 9%
 NO IMPACT to eelgrass if the stressor were to happen at a specific site (0) **3** 2%
 SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1) **18** 13%
 MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2) **57** 41%
 LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3) **50** 36%

Climate change [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



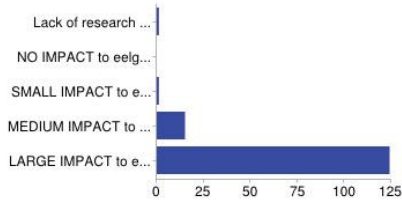
Lack of research or data **36** 26%
 NO IMPACT to eelgrass if the stressor were to happen at a specific site (0) **2** 1%
 SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1) **12** 9%
 MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2) **55** 39%
 LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3) **35** 25%

Commercial aquaculture [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



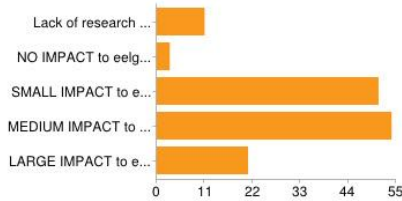
Lack of research or data **7** 5%
 NO IMPACT to eelgrass if the stressor were to happen at a specific site (0) **6** 4%
 SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1) **23** 17%
 MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2) **42** 30%
 LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3) **60** 43%

Dredging & Filling [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



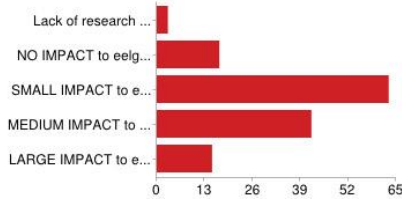
Lack of research or data	1	1%
NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	0	0%
SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	1	1%
MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2)	15	11%
LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3)	124	88%

Other marine vegetation [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



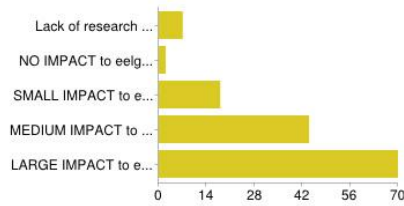
Lack of research or data	11	8%
NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	3	2%
SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	51	36%
MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2)	54	39%
LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3)	21	15%

Recreational resource harvest (e.g., clamming, fishing, crabbing) [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



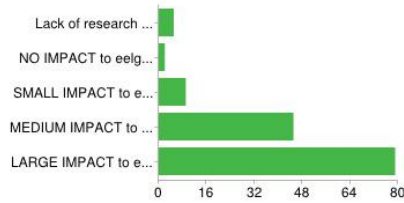
Lack of research or data	3	2%
NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	17	12%
SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	63	45%
MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2)	42	30%
LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3)	15	11%

Shoreline development [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



Lack of research or data	7	5%
NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	2	1%
SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	18	13%
MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2)	44	31%
LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3)	70	50%

Water quality [3a. Please rank the effect of each stressor on eelgrass if it were to occur at a specific site in Puget Sound.]



Lack of research or data	5	4%
NO IMPACT to eelgrass if the stressor were to happen at a specific site (0)	2	1%
SMALL IMPACT to eelgrass if the stressor were to happen at a specific site (1)	9	6%
MEDIUM IMPACT to eelgrass if the stressor were to happen at a specific site (2)	45	32%
LARGE IMPACT to eelgrass if the stressor were to happen at a specific site (3)	79	56%

3b. Do you have any additional comments in regard to stressors that affect eelgrass at specific sites in Puget Sound?

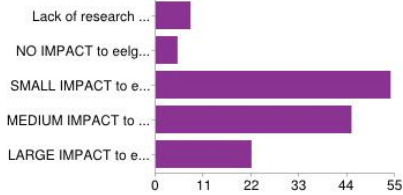
Aquaculture is pretty broad, the impact to eelgrass could be quite dramatic if, for example, a fin fish aquaculture net pen were sited over or adjacent to an eelgrass bed. However, shellfish aquaculture may have little to no impact. no Boating prop damage, Sediment shift Other stressors include: suspended sediment/turbidity leaking septic tanks that trigger Ulvoid blooms which shade & outcompete eelgrass. I indicated 'poor' on question 2, so don't feel qualified to continue with stressor questions. This raises an important question for your survey analysis. Will you weight the answers of the (self-reported) 'knowing' vs. the 'unknowing'? In social science surveys of resource systems experts often rate themselves as knowing less, that the un-knowing as they recognize a broader range of knowledge potential while the less-knowing can have naive assumptions about stressors, but check buttons with great conviction. How would you validate a responder's knowledge in an objective way? It doesn't seem that any questions here offer insight as to respondent knowledge base. nearshore garbage, debris, over-water coverage, existing and abandoned creosote piling also contribute to the stress upon urban shoreline habitats. Some of the most severe impacts to eelgrass beds that I have seen are in places like Port Angeles and Port Gamble where log rafting has been or still is practiced. Bark and debris from log rafting operations that sinks to the bottom turns the bed anaerobic and more or less permanently eliminates eelgrass. These areas can best be restored by covering this anaerobic material, without disturbing it, by 3 feet or so of clean sand. This has successfully established eelgrass just south and east of the Port Angeles Naval Air Station. Disease -- like at some San Juan sites is very serious Anchoring: serious where it occurs, boating and anchoring rules are often ignored Armoring, Dredging, .. depends, need sediments replenishing the site Climate Change: depends on time frame ; does it promote disease? The list above makes conclusions difficult because the magnitude of the stressor is not known, there is a difference between some anchoring and lots of anchoring. The combination accelerated sea level rise, and shoreline armoring presents a VERY LARGE IMPACT (coastal squeeze) as eelgrass migrates shoreward to stay within depth tolerances. Have you considered the impacts of reduced sediment inputs and low rates of estuarine surface elevation gain (accretion less shallow subsidence) and how this may also increase water depth? Please see John Rybczyk's work in Padilla Bay. Conversely, increased sediment loading and water velocities may bury and/or scour eelgrass beds. Please see Eric Grossman's work in Skagit Bay. IF anchoring is done correctly, for example I require -16 ft MLLW, a mid-line float and a helical anchor in central

sound I believe there will be no impact to eelgrass. However if an old engine block or crab pot full of rocks are used as an anchor at -4 MLLW, then I would change my answer to large impact. Similar for armoring, built above MHHW, the direct effect on EG is minor, limited to sediment retention and maybe beach coarsening, but built or reconstructed at +5 MLLW is another story altogether. I don't know! Impact from these stressors is related to the scope and scale (intensity) of the work so this is difficult to evaluate. For example, mooring one vessel for three days over the summer versus mooring three vessels all summer. This was difficult to answer because there is no reference to the scale of impact, other than "if it were to occur at a specific site". For example, the number of anchors and frequency of anchoring, time of year, etc., would have different impacts. Also, while it is likely that shore armor may adversely impact eelgrass, it depends upon location and the various effects of the bulkhead. Therefore, my responses are general and assume that as the alterations increase, so do the impacts. nonnative (invasive) herbivores such as marine snails. Shoreline development and climate change are too broad a category to score. The stressor needs more specificity for site scale assessment. It also appears you are not using the larger Puget Sound wide pressures/stressors terminology, which is unfortunate. docks and piers are stressors. They are not listed above. Is it because it falls under "shoreline development"? it should be its own line item stressor. I think there could be considerably more research into the mechanisms of stress on eelgrass and their interrelationships. There are some limited studies about specific impacts (for example, anchoring), which are great and have improved policy-making and overall conditions, but the connection of eelgrass loss to development and other maritime uses is not well documented. I think there has been too much examination of the link between shoreline armoring and eelgrass, where the link is not definitive - and remains a matter of debate. I would like to see more emphasis on the link with water quality, which my own research suggests is much more important. The link is likely very complex and the studies done to date have not been able to clearly establish the relationship between water quality stressors and eelgrass loss, even though most studies have identified some kind of link. Overwater structures, limiting light penetration, seem to be a strong stressor of eelgrass productivity. Familiar with eel grass located n Port Gardner, Jetty Island, Tulalip Reservation. Member Snohomish County Marine Resource Commission since 2008. Also active Beach Watcher Under anchoring, I would include mooring buoys with chains that drag over the bottom, creating halo effects. Scale of effect obviously related to the number of anchored/moored vessels. Overwater structures and their shading have indisputable effects on eelgrass at specific sites. Obviously, armoring can have large impacts, but these really depend on site and project details (extent of armoring, armor location relative to MLLW, location/distribution of the eelgrass, fetch / orientation of the site, etc.), as well as the types of processes (e.g., sediment supply) that have been altered. In other words, the web of cause-effect is too complex to make simple generalizations - so I'm stretching it to say Medium Impact. There are few good cases (besides the Lincoln Park work by Thom et al.) that document a single case well. not sure if these are all "large" impacts, but certainly all are substantial stressors. My interpretation of "dredging and filling" is directly on the eelgrass substrate. My interpretation of shoreline development includes changes in nearshore depth and overwater shading. I don't know if that is what you intended. Its difficult to answer 3a. Climate change, commercial aquaculture, shoreline development, in fact all of the stressors take different forms and intensities. Also the survey could use a "I don't know" category Commercial aquaculture will actually have a significant positive impact on eelgrass, yet I feel question 3a was referencing negative impacts. Areas where shellfish clear the water of light blocking algae and removal of ghost shrimp will often have eelgrass resurgence. A lot of these depend on the magnitude of the event/stressor. One boat anchor is kinda bad, 10 anchors in the same area are really bad. Boat prop wash is a significant stressor with a large impact. Certain specific shoreline development like piers shade out eelgrass. Yes, I am very impressed by urban sites like the Edmonds Underwater Park, where significant stretches of eelgrass have been brought back to relatively healthy conditions. Boat traffic, overwater structures The questions above leave some of the categories, subject to interpretation. For example, the impact of shoreline development would depend on what is developed, location on the shoreline in relation to the eelgrass bed, etc. Another example is the other marine vegetation category. Excessive Ulva resulting from eutrophication would affect eelgrass, but natural densities of other native macroalgae may not have such effect. Armoring would affect if done in association to fill that protrudes into the Puget Sound (below the mean water); if above the extreme tide elevation, then it may not have impacts. Why is overwater structure not included? How about boating? I cannot believe that Department of Ecology allows the commercial shellfish industry to spray poisons to kill the eelgrass around their shellfish beds. I think they are trying to kill the Japonica, but the fish that depend on eelgrass don't really care which species it is (native or Japonica), and the poisons cannot be contained to just a small area. Until this practice is banned, I don't believe that Washington really gives much concern to the matter of eelgrass. within shoreline development, I'm including in-water construction projects from residential piers to port/naval facilities. within aquaculture, I am including geoduck operations. prop-wash from larger vessels can be a concern. We've lost eelgrass beds in the same places we've lost shellfish beds. Namely, the eastern shore of Puget Sound from Everett to Tacoma. Eelgrass beds in the North Sound, Straits, Hood Canal and Willapa are expanding likely due to increased carbon abundance in the water column. The stressors affecting eelgrass can function very differently at different sites. Shoreline development can include an infinite number of actions and the effects on eelgrass can range from negligible to severe. All of the stressors in question 3a, above need to be evaluated individually at specific sites. what about changes in sediment sources? Elwa River and Skokomish River restoration examples. Climate change impacts could be positive due to water temperature change. Most stressors are assumed and not known for certain. It is not possible to answer the questions above without more information about the identified stressors, the impact categories, and the term site. For example, anchoring with a helix screw and lines with properly attached floats are likely to cause localized impacts in the immediate vicinity of the screw, and may cause greater impacts based on the type of vessel attached to the anchor, as well as the time period and time of year that it is attached. Anchoring with an old boat engine, surplus concrete blocks, or other materials attached to loose chains that scour the seafloor typically causes greater impacts. In addition, the geographic scope of the term site would impact the magnitude of the impacts. This list also omits overwater structures, a potentially significant stressor identified elsewhere in this survey. We know that commercial geoduck farming destroys everything in its path. I don't really know how recreational harvest and climate change have impacted eelgrass. While there indeed may be impacts due to armoring, they are indirect and therefore very difficult to quantify. Correlation is not causation, and currently I have not seen direct cause-effect studies of armoring to impacts on eelgrass while accounting for all the other variables potentially impacting eelgrass. Similarly, climate changes impacts or difficult to determine. While climate change models suggest impacts to eelgrass in more southern latitudes of the eastern US, I have not seen any specific data in the Pacific Northwest. I acknowledge, this may be a dissemination issue. Japonica should not have been listed as a weed to support more nonnative shellfish why did you not ask about overwater coverage. Assumed shoreline development did not include docks and piers?? Climate Change could enhance eelgrass growth with increased CO2 in the water column. Japonica competes on the fringes but also creates habitat as it pools water higher

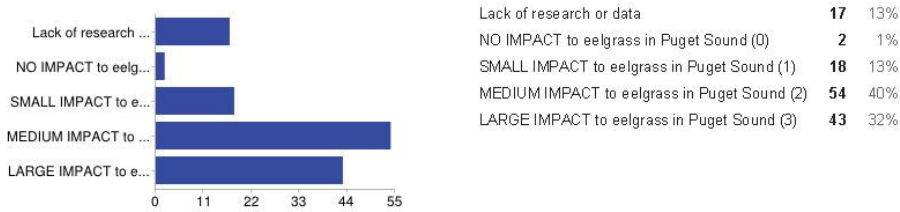
on the beach, as seen in Willapa. It depends on the buffer distance of the stressors to the eelgrass. It also depends on drift cell location if looking at bulkheads and development. If recreational harvest, what type of harvest will vary the impact. Biggest effects on eel grass I continually see if eutrophication of marine waters in South Puget Sound. The shellfish industry claims that oyster production sometimes benefits the establishment of eelgrass, or is at least neutral. Is that claim valid? Shoreline armoring typically occurs at tidal elevations that are markedly higher those occupied by eelgrass beds. Obviously, building a bulkhead in an eelgrass bed would have a significant impact but I'm not sure this stressor is presented in a realistic context in the question above. Recent work in the PNW is suggesting that outer coast estuarine eelgrass may be rather stressed to warm water temperatures, more so than by nutrients. Nutrient loading is the largest impact and is the actual stressor effecting several of the issues above. Sediment loading from watershed activities is likely the second greatest impact, but it's not in your list above. The question is so open the answers you get could mean different things. What is a "specific site", a bed, a cove, a bay, or inlet? commercial aquaculture would depend on harvest species and method. Certain kinds of commercial fishing and shell fish aquaculture can have high impacts. Also, recreational boating, many of your categories can have high impact in very limited areas but are not otherwise widespread. There is a lack of good research to account for the widespread loss of the species. In 3a above these are very general statement. Most of these activities could have high or virtually no impacts depending upon how they are carried out and with what equipment and materials. For example a mooring bouy in water -18MLLW following installation BMPs would have vey small impacts but one in -6MLLW could have high impacts. I think these statements are to vague to provide any usable measure of impact as they are open to wide interpretation. Run off from large urban areas. Suspect contaminate run off and herbicide applications for spartina in our area may be have caused challenges to eelgrass in our location. Impacts are very variable based on implementation of BMPs. Also, armoring takes a long time before having impacts on eelgrass on its own (through interruption of the sediment supply and potentially increased erosion throughout the tidal prism), but the corresponding development may have more immediate impacts. Impacts on a site specific basis regarding aquaculture is assuming that they would be implemented with current guidance on mitigating impacts to eelgrass. It is unlikely single effects are an adequate explanation for losses of eelgrass in a given area. Rather it is likely the mix of cumulative effects that impact whether eelgrass are likely to persist. Herbivory could be considered a stressor, especially as it relates to species with dramatic abundance changes in response to climate change or shoreline development (e.g., snails, small crustaceans). I have seen it in our Cove (some fresh water coming in from stream) in the inter-tidal zone and last summer found a patch at the low-low water at about a -3.8 to -4 level which was reported to DNR. There would be only natural stressors (climate, weather) or man caused (geoduck harvesting, etc.) since it is too muddy for any other activity. Often a combination of stressors are causing impacts at specific sites. Climate change is difficult to predict. Eelgrass in Puget Sound is below it's temperature optimum, so a bit of warming won't hurt here. Will climate change lead to more or less light? More or less turbidity? I don't know if predictions for Puget Sound on these latter two are precise enough to make a call. Ocean acidification might be an issue. However, eelgrass seems to be less affected by this than other marine species will be. Asking about anchoring is tough - if it is a bed that receives little boat traffic than I would think the impact would be small. If it is a bed that receives a lot of boat traffic the impact would be large. I ranked the impact as a medium to represent an average. Most of the bulkhead research I have done has shown high impacts on higher elevation species such as bugs - but lower impacts as you go further down in elevation. dredging & filling would be project dependent. Overwater structures would have far greater impact on eelgrass than would shoreline development without such structures at every parcel. nitrogen loading needs to be addressed by the WA State Department of Ecology. No, but this question and 3a and 3c would be difficult to answer if a person did not have a sense of what a stressor was. Should add a "I don't know" component to these kinds of questions. Is Grey whale feeding a stressor in localized areas? Response assumes shoreline development includes overwater/in-water construction. Most things can have an effect on eelgrass. Can be both good and bad. Unfortunately, most are bad. Some of the stressors may greatly impact distribution but may only marginally impact abundance (e.g., sealevel rise may displace eelgrass into the current intertidal). Also, water quality will only have a large effect if it impacts light availability (increases attenuation) or increases nutrient loading leading to increased macroalgal growth. The categories above are so broad it is difficult to select an impact level. For example, I believe recreational clamming has a large impact on eelgrass, but fishing has no impact. Prop wash from boating. Assumed shoreline development was meant to imply overwater structures as opposed to amoring... Nutrient enrichment from urban landscaping, agricultural waste, inadequate sewage treatment and finfish aquaculture. Nutrient enrichment favors the growth of Ulva and other fast-growing algae and epiphytes both of outcompete eelgrass for light. Nutrients also lead to turbity which reduces the depth in which eelgrass can live. The degree of impacts is significantly affected by conditions at the site. In some cases, a sea wall will not affect a nearby fringing bed, but in another situation, the sea wall could affect the width, density, functions, and viability of a bed. Anchoring methods have improved with mid-line floats and embedment type anchors to limit impacts. No control, however, over nonauthorized mooring buoys. Saw flowering eelgrass at two mitigation sites two years ago were this was not documented previously. is this due to warming seawater or other factors? In Willapa have observed countinual disturbance to eelgrass beds and the beds continue to be robust. Bivalve culture may benefit eelgrass through nutrient input. Always a concern at mitigation sites that native veg may out compete transplants. Shoreline defvelopment and armoring big concern if sediment supplies are cut off. Invasive Species are displacing Marina. For instance, japonica has expanded its infestation into areas historically inhabited by Marina. Clearly there is a competitive impact occurring and this has been an issue of concern with marine ecologists. Its important to specify the species we are talking about, and thus the use of the general term "Eel grass" should be avoided. If we are talking about Marina, then use this name as the reference.

Anchoring [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]

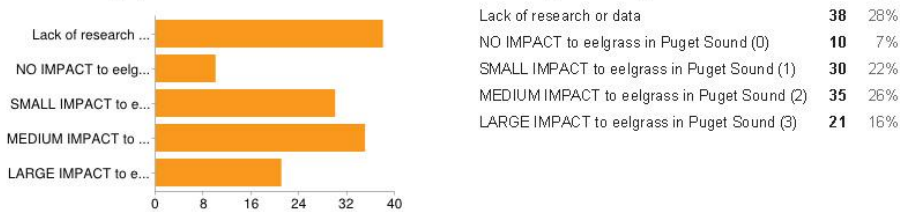
Lack of research or data	8	6%
NO IMPACT to eelgrass in Puget Sound (0)	5	4%
SMALL IMPACT to eelgrass in Puget Sound (1)	54	40%
MEDIUM IMPACT to eelgrass in Puget Sound (2)	45	34%
LARGE IMPACT to eelgrass in Puget Sound (3)	22	16%



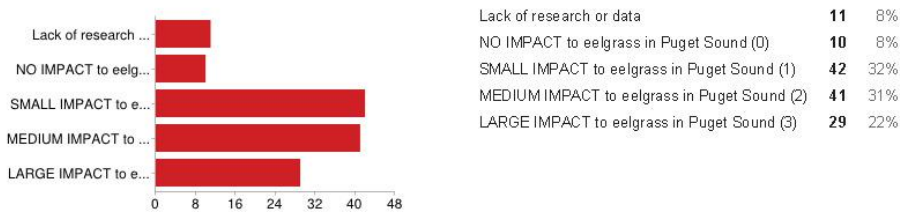
Armoring (seawalls & riprap) [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]



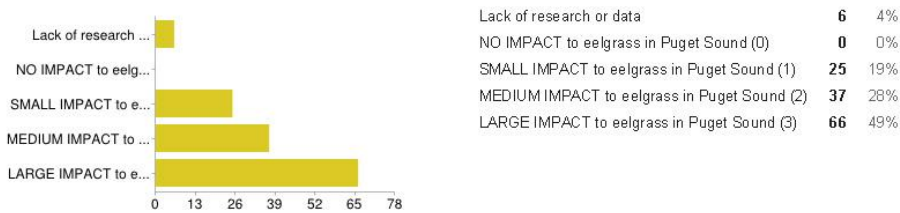
Climate change [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]



Commercial aquaculture [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]

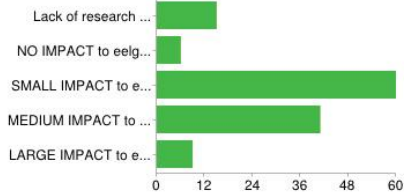


Dredging & Filling [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]



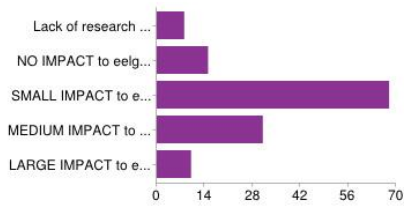
Other marine vegetation [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]

Lack of research or data	15	11%
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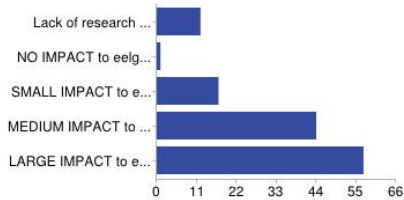
Lack of research or data	6	5%
NO IMPACT to eelgrass in Puget Sound (0)	60	46%
SMALL IMPACT to eelgrass in Puget Sound (1)	41	31%
MEDIUM IMPACT to eelgrass in Puget Sound (2)	9	7%
LARGE IMPACT to eelgrass in Puget Sound (3)	0	0%

Recreational resource harvest (e.g., clamming, fishing, crabbing) [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]



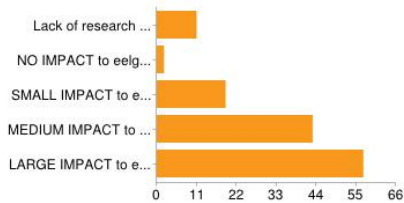
Lack of research or data	8	6%
NO IMPACT to eelgrass in Puget Sound (0)	15	11%
SMALL IMPACT to eelgrass in Puget Sound (1)	68	52%
MEDIUM IMPACT to eelgrass in Puget Sound (2)	31	23%
LARGE IMPACT to eelgrass in Puget Sound (3)	10	8%

Shoreline development [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]



Lack of research or data	12	9%
NO IMPACT to eelgrass in Puget Sound (0)	1	1%
SMALL IMPACT to eelgrass in Puget Sound (1)	17	13%
MEDIUM IMPACT to eelgrass in Puget Sound (2)	44	34%
LARGE IMPACT to eelgrass in Puget Sound (3)	57	44%

Water quality [3c. Please rank the effect of each stressor on eelgrass in Puget Sound at its current state.]



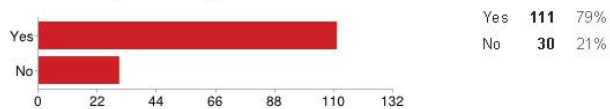
Lack of research or data	11	8%
NO IMPACT to eelgrass in Puget Sound (0)	2	2%
SMALL IMPACT to eelgrass in Puget Sound (1)	19	14%
MEDIUM IMPACT to eelgrass in Puget Sound (2)	43	33%
LARGE IMPACT to eelgrass in Puget Sound (3)	57	43%

3d. Do you have any additional comments in regard to stressors that affect eelgrass in Puget Sound?

no Armoring associated with fill that protrudes into Puget Sound affects sediment transport and deposition, and thereby eelgrass. However, this does not happen everywhere armoring occur. Why is overwater structure not included? How about boating? The effects of upland development on water quality should be considered. Oil spills: I have significant concerns about the potential fate of eelgrass with increased oil tanker traffic in the Strait of Juan de Fuca. I don't believe adequate measures are in place to protect eelgrass in the event of a major spill. This is a confusing question and I'm not sure what you mean by "in it's current state" Water quality and soft shore armoring retrofits to existing outfalls and shoreline stabilization methods would be required to have any measurable impact on the current state. Currently water quality and armoring is only looked at for new development actions not existing infrastructure. Often dredging is seen as a waterway maintenance action which is not regulated with the same scrutiny as new development. As the State's various Shoreline Master Programs are updated the occurrences of new anchoring, armoring, dredging, development and degraded water quality inputs should decrease if the SMP's are properly implemented. See above. I assume that other forms of shellfish aquaculture (other than geoduck farming) also impact eelgrass in Puget Sound. If "other marine vegetation" (non-native) is either introduced by the shellfish industry or if their activities (chemicals) destroy other native vegetation, then that is a problem. I don't know if recreational harvest has a big impact. If it does, it should be curtailed. shoreline development, armoring and water quality are currently the largest impacts on Z marina in Puget Sound. The impact of climate change is currently unclear due

to the complexities of the forecasted changes. I do not believe that there is enough good science to make these kinds of rankings at this time. As I noted above, many activities with potentially high impacts are not listed. Some of them can have large impacts (shell fish aquaculture is an example) when concentrated in estuaries. Scouring from the prows of recreational and commercial boats might be another. So would chemical inputs from uplands agriculture, silviculture, and residential landscaping. Yes, I'm limited by the fact that I've only been diving at a dozen sites in Puget Sound and another dozen in the San Juan Islands. Placement of helical anchors has less impact than other types of anchors. Water quality could include impacts from outfall discharges, nonpoint sources (including stormwater and septic tanks), changes in freshwater inputs. Shoreline development includes overwater structures, shading. My understanding is that there are not specific data to show impacts from the actions shown above. In addition, the list above should include overwater structures. A November 2013 paper from Australia showed dock impacts to eelgrass. Not sure about stressors but more needs to be done to locate where it is growing and protect patches so they will continue to thrive. There is a need to locate estuarine areas and educate people about the various sea life that thrives in these areas. Would like to qualify we believe the water quality, especially in the South Sound, is impacting, but we do not have enough longterm data to definitively say so. assuming that armoring occurs outside where it occurs Water quality effects are likely site specific and limited to areas with limited flushing (small, developed bays like Eagle Harbor). Is this my best professional judgement or documented effects? If the former, I would rank Armoring as Medium, climate change as small, commercial aquaculture as medium, other marine veg. as small, recreational harvest as small, and shoreline development as large. Shoreline development should be broken down into two categories: 1) nearshore (i.e. upland) development - having some impacts related to general upland conversion 2) associated overwater coverage related to that development That is, upland shoreline development has ecosystem impacts, but they may be indirect (like armoring) or of lesser impact. In comparison, additional development associated with putting a house on the waterfront can lead to greater impacts: e.g. boating activity that sheers eelgrass, overwater coverage (docks) that shade out eelgrass. other vegetation = *Zostera japonica*, an invasive species. While some data do exist, and we know that each of these stressors can and do have adverse effects, I do not believe that we know enough to rank each stressor. How can I answer 3a/3c? All of these stressor impact eelgrass so I evaluated based on the typical scale of the work and what is currently allowed under local, state and federal law. Since water quality is directly linked to shoreline development I rated this high. It doesn't mean I think constructing a house on the shoreline will impact an adjacent eelgrass bed. WQ is a cumulative effect of development. Anchoring often occurs in embayments with eelgrass, and can occur at high densities and rates (e.g. Echo Bay, Sucia Island). Armoring has caused significant interruption to sediment supply in many areas of Puget Sound, possibly reducing the availability of suitable substrate in areas) Existing commercial aquaculture occurs in several existing large eelgrass meadows (Willapa Bay, Samish Bay), and can cause large disturbances to eelgrass during harvest. Dredging and filling has removed large areas of likely suitable habitat for eelgrass meadows (e.g. Commencement Bay, Elliot Bay. No Nutrient enrichment from urban landscaping, agricultural waste, inadequate sewage treatment and finfish aquaculture. Dredging is regulated so should not occur in eelgrass sites without approved mitigation. Rapid changes in weater quality may be a primary reason for die offs following storm events. Proposed abatement of invasive eelgrass for shellfish production may have unintended negative consequences on the native eelgrass. I don't really know. I don't know much about how these things are currently impacting eelgrass in Puget Sound. Commercial aquaculture, while only conducted in relatively limited areas of Puget Sound, is frequently conducted without any regard to eelgrass that may be present in the cultured area. Things like oyster dredging, oyster rack culture, floating mussel culture, rototilling to kill moon snails, and hydraulic clam and geoduck harvesting, when done in eelgrass beds, basically completely destroy them, and there is no regulatory oversight of these activities. Ocean acidification could increase eelgrass beds - one of the few positives of acidification. Climate Change could enhance eelgrass growth with increased CO2 in the water column. Japonica competes on the fringes but also can creates habitat as it pools water higher on the beach.. Difficult to answer this section as the impacts are quite varied throughout Puget Sound, for example, some areas are much more impacted by water quality issues whereas other areas have greater flushing and are less impacted. Also areas that have high boater usage could be much more impacted due to anchoring than areas that are rarely used by boaters. The impacts of these "stressors" is completely situation specific. Dredging and filling are commonly done to restore eelgrass for instance. Armoring may be fairly benign or completely destroy an eelgrass bed depending on the design and nearshore conditions. While the stressors mentioned above are accurate, it is their effect on eelgrass controlling factors such as light, temp, substrata, nutrients, that need to be monitored. The ranges for these factors are well documented. In addition, other stressors include invasive species, suspended sediment, sea level rise, overwater structures, bioturbation, prop wash, anthropogenic contaminants, organic matter discharge/sulfates, freshwater input and overfishing. Responses based on new incremental impacts moving forward - they do not account for total historic impacts. For example, the impact of dredging would be larger from a historical perspective, however, existing regulations should reduce incremental damages moving forward. Same with aquaculture. the effects of all stressors would be even greater if they are combined at a given site. Boat prop damage Oil Spills I am not understanding the distinction for Q3c Why the redundancy? Depending on the density of recreation visitors to the near shore areas, Marina can have some short term impacts. Policy should prohibit or limit recreational access to public marine lands at some times. boat traffic, aquaculture, overwater structures I don't know that a lot of dredging/filling currently occurs in/near eelgrass habitat. Certainly potentially a strong stressor but not sure about actual impacts from these practices. See my comments above. I don't actually feel qualified to answer this. it depends on the level of each of these activities in areas specific to eelgrass and the duration of disturbance, whether transient or chronic. there might be information such as this available in the near term thru salmon recovery efforts of local watersheds to develop monitoring plans.

4a. Will changing policies that protect eelgrass from direct impacts (e.g., dredging, overwater structures, mooring buoys) enhance eelgrass in Puget Sound?



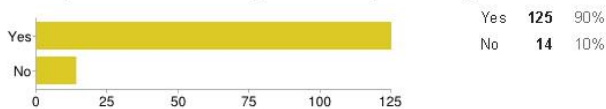
If YES, please explain and provide an example of policies that need to be changed.

test riprap and seawalls need to be stopped anchoring and shoreline development severely limited. Low tide navigation rules are different than high tide rules. Boats should follow channels that avoid eelgrass beds. Mooring buoys properly installed are much better than individual anchors. Increase voluntary no anchor zones. The "Yes" response answers only the question about enhancing. I do not see the need for more restrictive policies. Policies are already out of balance, to the point of making it unreasonably restrictive and expensive for people to make a living here. What is needed is objective research and honest analysis of data to know what stressors are real and which ones have no or little effect. Frankly I don't know because I don't know the current policies. All I can say is that if NO dredging, over water structures or mooring buoys existed, sea grasses would be better off. In other words, less impact on eel grass environment would be better. This does not answer your questions on policy. I don't mean to be critical, but this is a frustrating survey and could have been better constructed given your intended audience and objectives. Usefulness debatable given nature of questions and quality of info you might receive. All these known stressors should be tightly regulated and generally prohibited where eelgrass beds of significant size are located nearby; certainly mitigation required for direct impacts. All mooring buoys should require permitting (and fees). All shoreline armoring should require mitigation. Changing policies will protect eelgrass if the policies include curtailing geoduck farming and other intensive shellfish aquaculture that destroys eelgrass or makes it impossible to come back. changing how, increasing protection? preventing anchoring in eelgrass beds rather than voluntary exclusion would enhance eelgrass. These policies might enhance eelgrass in some sites but will not likely result in large improvements across Puget Sound. Shoreline protection measures and enforcement of building codes need to happen. I am not well versed on any specific policies but I think that if you are enforcing a policy that protects eelgrass, than eelgrass will be enhanced. Delineate, educate and enforce anchoring out of eelgrass beds. Even with mitigation, ie grating, docks over eelgrass still impact eelgrass beds. There are still a lot of issues and unknowns with mitigation in aquatic environments. Even with wetlands, that we theoretically know much more about, the mitigation success is pretty low. Overall, policies should be more oriented towards AVOIDING impact rather than trying to mitigate. I believe the rigorous enforcement of existing laws regarding mooring buoys is a great example that if it could be applied to other stressors (e.g., water quality) would improve conditions throughout the Sound. We don't necessarily need new laws. We just need to fund and implement enforcement of the ones we have. Updated and protective SMP policies would be the best means of protecting existing eelgrass from direct impacts. An example policy would be one that allows constructing an overwater structure at each parcel, rather than requiring a shared structure that is suitable sited to reduce or eliminate impacts. Enhance is a poorly descriptive term for this example, as protecting existing eelgrass may not actually "enhance" overall eelgrass presence, but will slow or prevent the decline. Change policies on water dependent uses and mitigation. No local, state or federal mitigation truly get us to no-net-loss. If laws prohibited a net loss of eelgrass that would get us closer. Compensatory mitigation allows the project proponent to provide substitute resources. If replacement of eelgrass is allowed, jurisdictions should have the ability to require a performance bond for long-term maintenance, monitoring and any contingencies needed to meet the performance goals. To many replacement eelgrass mitigation projects fail. I'm hoping that policy changes that protect eelgrass from direct impacts would help eelgrass (a bit of a leading question). Limiting anchoring to zones beyond the depth that eelgrass can grow and providing mooring buoys in areas frequently used by boaters. Limiting boats using anchors, enhancing restrictions on property owners, and restricting further dredging would increase eelgrass success. The state laws necessary to protect eelgrass already exist (e.g., WA Hydraulic Code, WA Shoreline Management Act, WA Department of Natural Resources' trustee obligation to protect eelgrass as public resource, federal Clean Water Act, Endangered Species Act). However, the political will to implement those laws has proven more difficult to find. I am not a policy maker - but it seems like you could simply say no dredging is allowed when eelgrass beds are present. Overwater structures could occur if they allowed enough light to penetrate through to the seafloor. One or two mooring buoys wouldn't be the end of the world, but a lot of them would decrease light penetration (from the moored boats) and disturb beds from chains. I'm always curious how Z. japonica is dealt with as well - do you protect a non-native species? Any policy change that limits destruction of existing meadows or provides for establishment of new meadows in novel areas could be beneficial. Increasing the setback of shoreline armoring to allow shoreward migration of meadows in lockstep with sea level rise would be beneficial. While some are already in place, additional policies requiring eelgrass-friendly construction of overwater structures are needed. Shouldn't there be a third category: unknown? Propose avoidance policies and impact mitigation similar to wetlands protection for activities that directly impact eelgrass. Include eelgrass as part of the state and local "in lieu fee" programs or build a separate program for marine macro algae. I do not have any. Just stands to reason that prohibiting dredging for example would enhance eelgrass. Any direct impacts need to be avoided or at least mitigated. Laws are necessary to enforce this. Reduced shoreline and estuarine development in any way that increases light penetration to depth will enhance eelgrass. WDFW HPA programs: armoring, dredging, etc. Local government shoreline master programs. currently marina maintenance dredging requires no mitigation for habitat impacts 2-yr statute of limitations, and limited penalties for violations of regulations are not an effective deterrent and make enforcement of current policies less effective. As a result of more research the importance of maintaining healthy and abundant eelgrass is becoming more widely accepted. SMP update guidelines are including measures to help improve eelgrass habitat conditions. However, more needs to be done since SMP updates only require no net loss which doesn't do much to support restoration of habitat. More needs to be done about environmental problems arising from expanding aquaculture activities, particularly geoduck farming. Commercial aquaculture stresses all aspects of the tidal environment, including eelgrass. Besides the deteriorating quality of water in Puget Sound, commercial aquaculture is the biggest threat to the natural environment. These policies don't do nearly as much as they could for protecting eelgrass because variances that allow impacts are extremely commonplace. Policies need to be changed to prevent variances or provide for a reasonable ratio of compensatory mitigation. Additionally, appropriate agencies need a system in place to verify mitigation and compensatory mitigation projects actually occur, and execute enforcement actions when they are not. Currently there are many policies to protect eelgrass in Puget Sound regarding docks, moorings and dredging. As stated previously, we do know that there are direct (and indirect) adverse impacts from all of the stressors you have listed. A critical policy change would be to take the Precautionary approach to allowing any alteration, requiring the project proponent (i.e., aquaculture industry, port, private landowner) to prove no harm rather than forcing state or other entities to prove harm. Also, additional monitoring and enforcement are sorely needed. I do not have specific knowledge of Washington State shoreline policies and cannot provide specific examples of which policies need to be changed. However, I am confident that the suggestion above provides a logical and feasible alternative that may enhance eelgrass in the Puget Sound. Clear, effective permitting processes for any nearshore disturbances --- from an overnight anchor, to a 100 meter dock., to an oyster bed, to salmon net pens clear, effective

regulations for land-to-nearshore water transport (septic, sewer, storm water) But not a big effect Sound wide. I don't think much dredging occurs in eelgrass areas, and significant overwater structures are mostly limited to ferry boat landings, so not a big factor. - require any new docks, piers, conveyor belts, and over water structures to be day lighted. - prohibit mooring buoys and anchoring in sensitive areas. - prohibit commercial shellfish/aquaculture in sensitive areas. Current HPA regulations already address much of this. Not sure what else they could add. Dredging at terminals has eliminated and shadowed much of our native eelgrass beds. Stop the dredging. No, water quality, beach armoring and shoreline development are the biggest issues. Direct impacts from anchoring, shellfish harvesting, etc. and short term and temporary and many orders of magnitude less than a large wind storm. If the right water chemistry, and clarity exists eelgrass recovers very quickly on its own. Theoretically, damage to eelgrass due to direct proximity construction (e.g., overwater structures) is already mitigated for, but keeping impacts out of the eelgrass zone that are ephemeral (e.g., mooring) or diffuse (e.g., shoreline armoring) are less controlled. Sometimes the solution to these impacts is to simply move to deeper water where the eelgrass does not grow. Changing policies, especially regulatory ones will have little impact without associated funding to support compliance monitoring and enforcement. Eel grass is not impacted long term unless the stressor is constant. Short term impacts have little affect on Marina as it recovers well unless water QA conditions are altered. Upland run off from shoreline developments is a significant problem where policy should be altered to increase setback requirements and storm water runoff protections. Shellfish aquaculture should be encouraged as much as possible as this is a documented method of increasing Marina coverage and providing alternate and equally valuable habitat. Avoiding impacts rather than uncertain mitigation on or off site for any new development. Strengthen smp's, hpa's, water quality standards that limit nutrient inputs, etc., to prioritize eelgrass conservation. Present regulation, IF ENFORCED should provide enough protection for eelgrass, specifically those development projects within the nearshore environment (rip-rap, sea walls, docks) that impact sediment transport within drift cells. As shorelines are hardened, finer sediments needed for eelgrass are replaced by larger substrate. We have the regulations in place to minimize shoreline/bank hardening but seems landowners repeatedly are granted waivers or local government is unable to enforce the regulations to make sure the original permit was followed. Policy change needs to recognize the need to better enforce what is already on the books. Shoreline management plans are currently being updated or else need to be updated in all areas of PS. Stronger policies need to be incorporated in these SMP's. And local political entities must have the will to support good environmental practices that prevent degradation of marine nearshore habitats. We have a mandate under ESA to have "NO net loss of salmon habitats", but current information suggests this is not the case. Corps/WDFW policy on construction impact analysis of eelgrass for permitting should be stronger. ESA listing should be considered. Policies on dredging that protect eelgrass (existing and historic areas), regulating mooring and anchoring in eelgrass sensitive areas and limiting overwater structures and retrofitting existing structures to reduce impact to eelgrass- I think this last one needs more research, however, if retrofits actually help. Since dredging and overwater structures have a strong impact on the growth and survival of eelgrass, any change in limitation of these structures will affect eelgrass. I think the policies are already in place; they just need better awareness and enforcement (probably more effective to first educate and incentivize through the communities rather than with tickets). The first issue is for jurisdictions and agencies to apply and enforce existing regulations. To do this of course requires legislators both local and state to recognize the value of this resource and the need to preserve it. I do not think the long-term political will exist to do this so changing any policies would be moot. Please contact me if you wish to discuss further. Thanks Too big a question. There are a large variety of ecosystems to consider. However the 'clear cutting' of native sea life, massive planting of georuck farms and subsequent dredging of the marine environment will no doubt in the long term create major changes in the balance of sea life. The huge mussel farms with critters brought from outside native Puget Sd., the parasites that are coming in from outside the P S. area have long range consequences. Regulations need to be tightened. Shorelines need to be kept natural and the inter-tidal zones protected RCW 79.105.430 Private Recreational Docks and Mooring Buoys Yes, but for the most part in small ways. These are aggregate impacts but are probably not enough to explain the widespread decline of a species. No dredging in/around eelgrass beds unless area surveyed and impacts (if unavoidable) mitigated and monitored for xx time period. Overwater structures must allow passage of natural light (grates, narrow width, taller structures, etc.) permitting overwater structures needs to additional consider eelgrass impacts Is the eelgrass protection buffer for in-water projects in Puget Sound only 10-15 feet? If so, I don't think that's sufficient, especially when nearby activities (dredging, aquaculture) likely result in increased suspended sediment (ie. reduced light, potential smothering). I think that San Francisco Bay uses ~45 foot buffers - and they naturally have high background levels of turbidity/suspended sediment. there is enough policy right now that protects the direct impacts on eelgrass. Don't know Overwater structures and non-point pollution are perhaps the most important and need to be strictly controlled. Climate is probably the most important long-term, but is also the least controllable. It is possible but would have to replant in areas that had eelgrass to obtain the survivability. Require more protections at the local level under Shoreline regulations. Change water quality standards to limit nitrogen inputs to concentrations that are protective of eelgrass. Completing SMP updates; applying habitat conservation measures to nearshore areas that historically supported eelgrass habitats to support future recovery; mooring buoy management plans, no anchor zones, etc. Prohibition of direct impacts is politically infeasible for some high profile projects. Many policies are currently in place. Increased monitoring and enforcement may be necessary to ensure compliance. need more clear requirements for avoiding eelgrass impacts and guidance for mitigation. also need to look at toxic cleanup sites around Puget Sound and how they impact eelgrass, including studies about thin sand capping. I don't think that changes to these rules will make a big difference since they already require mitigation and/or generally result in rather small impacts. But only if enforced. Currently, most jurisdiction allow activities that will impact eelgrass (SMP and CAO). WDFW also allows and so does the Corps and the Services. They all require mitigation; which in many instances does not work. society needs to decide; it is not a technical or scientific question anymore. Impacts need to be mitigated. Mooring buoy design improved to prevent bottom scour. Minimize mooring buoys Not a policy person per say but limiting habitat degradation would be critical for eel grass zostera maraia survival. Not sure of specific policies - just seems that protecting eelgrass from direct impacts would enhance Puget Sound eelgrass. Common sense answer. First, stop the unnatural disturbance. That is a fundamental precondition for effective restoration. better control of moorage along shorelines; consideration of boats & ships associated with overwater structures. However, I think that eelgrass is also impacted by longterm changes in water quality and other issues to be determined that won't necessarily respond to policy changes. Damage to eelgrass beds from boat traffic at low tides is unlikely to be a policy change. Mitigation plays a big role on impacts. Require changes to policies for projects that directly impact eelgrass. Require eelgrass mitigation (preferably spacial and temporal mitigation) if eelgrass is to be dredged, or impacts are shown to occur. Transplantation is becoming successful enough to provide function and values restored if eelgrass is required to be removed. Yes, however, WDFW has a no net loss of

EG policy that is not enforced or monitored. And the ability to say no is challenged by property rights and politicians at every step. Illegal construction does still happen and is very hard to remove once in place, often mitigation does not get near>NNL. At the federal level dredging is done w/o state review. EG is also lost to maintenance dredging routinely as the baseline condition is a dredged footprint with no EG in it. There are no laws protecting eelgrass from prop scour or jet wash in front of boat launches in particular and shorelines everywhere. A speed limit close to the shoreline or in shallow water would be nice. Also, there is no regulation protecting eelgrass from shade cast by barges and vessels. We seem to have very few aquatic use regulations in this state at all, even though we have a strong hydraulic code regulating construction. Finally, there is no regulatory oversight of aquaculture activities conducted in eelgrass. Rein in the shellfish industry change policies HOW??? It all depends.... If you enhance eelgrass protection, it will help; if you diminish eelgrass protective policies, it will hurt! Don't have adequate background/knowledge to provide details. Such policies would protect existing eelgrass beds. It is unclear how this would enhance (which I take to mean 'increase') eelgrass presence, unless certain existing activities or structures were removed from areas with impacted eelgrass beds. Avoid anchoring in eelgrass beds (although I am unsure how much anchoring in eelgrass beds actually occurs) But restoration of the eelgrass beds takes time. Again, my main concern is the impact of commercial shellfish production and harvesting. When the geoducks are blasted out of the substrate, the eelgrass that is above them is also blasted out, and floats away. This should not be allowed. When clamming is allowed on beaches (at low tide), there is also often eelgrass bed destruction. We are working to stop this practice on our public beaches on Bainbridge Island. Require eel grass surveys before permits. Zero degradation permitted. Mitigation policies (e.g. mitigation sequence required for HPA) are in place that, if upheld and enforced, adequately protect eelgrass from direct impacts. Eelgrass is already protected from direct impacts, it is the cumulative and indirect impacts that need to be addressed. Furthermore, additional guidance for local jurisdictions about necessary buffer zones around existing eel grass beds. For example, if someone is proposing shoreline development including shoreline hard armoring or bulkhead and new overwater coverage in the form of docks, gangways and mooring spaces, what is the appropriate distance that intensity of development should be set back from the existing eelgrass? And even with that buffer area would that inhibit the expansion of the eel grass? Ows are allowed under most SMPs. There are not even requirements or incentives for multifamily OWS in most SMPs. WQ effects from developed shoreline lots is not well understood and there are no requirements to do so. There is a general lack of compliance and enforcement at all levels of govt. No one gets in serious trouble for land use violations. Passive compliant based enforcement needs to be changed to jurisdictions actively enforcing shoreline regs. I believe the distribution of eelgrass shifts pretty regularly over temporal and spatial scales creating a challenge in assessing the effectiveness of policies aimed at protecting eelgrass, but fr example limiting shoreline armoring would likely improve the chances of eelgrass survival. For 20+ years there's been discussion of a WAC limiting or prohibiting hard armoring of shorelines... but the political will has never existed to pass such legislation. Development (i.e. docks, aquaculture) is allowed in areas where eelgrass is currently not growing, but could migrate to over time if the development were not to take place. There are already multiple policies that pertain to eelgrass in WA state: Shoreline Master Program Guidelines, Hydraulic Code, WA SEPA, Growth Management Act, CWA Regional Permits, Magnusen Stevens Fishery Mgmt and Conservation Act, and CWA 40 CFR 230.43, 404(b)(1). It is the assessment of impacts that needs to be utilized and improved through adaptive management that include appropriate measurement/monitoring not currently funded sufficiently to provide significant information to adapt policies. This includes collection of appropriate data from reference locations to understand natural eelgrass bed dynamics. unsure It is not the policies that need to change as much as agencies need to actually follow the policies they already have instead of constantly giving out exemptions and waivers. Policies that encourage shoreline armoring, nearshore dredging and the building of new overwater structures need to be changed. Policies that encourage more shorelines and bays NOT to allow these practices need to be adopted. As for mooring buoys, there need to be ten times more to avoid the anchor dredging that we scuba divers routinely encounter. Too bad that Jerry Garcia is no longer around to fund their installation!

4b. Will changing policies that protect eelgrass from degrading environmental conditions (e.g., poor water quality, nutrient loading, and sediment loading) enhance eelgrass in Puget Sound?



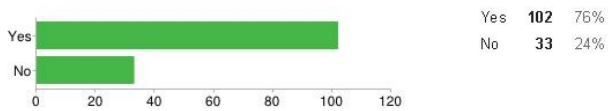
If YES, please explain and provide an example of policies that need to be changed.

This is directly related to ulva growth and plankton blooms which can impact eelgrass. test Water quality major stressor for PS and possibly eelgrass (see above). makes sense if water quality is improved eelgrass may be less stressed and less susceptible to disease. Perhaps policy has already been changed with the new state-wide LID requirements for treating storm water run-off, but ANY improvements to water quality (esp storm water) would be a boon... Also, I have been hearing a lot about wood waste leachate impacting eelgrass. Can we make remediation of wood waste (and other contaminated sites) near eelgrass a priority? See explanation above. The bureaucratic endpoint is enhancement to the point of no living in Puget Sound basin Without good water quality, any effort to enhance eelgrass will be a waste of time. Similar to above. better choice would be maybe, and maybe not. The only water quality issues would be turbidity and an excessive amount of nutrient loading. Some nutrient loading may be beneficial. Sediment loading occurs naturally and builds up intertidal and subtidal mud and sand flats that eelgrass grows in. If there were no sediment loading, then over time the available habitat would be reduced. So while sediment loading might be a concern, it might also be a benefit. If truly enforced. Permitted outfalls near eelgrass should be specifically analyzed and managed to protect eelgrass. I am not well versed on any specific policies but I think that if you are enforcing a policy that protects eelgrass, than eelgrass will be enhanced. The current understanding of sediment re-distribution in response to shoreline hardening in Puget Sound is insufficient to allow policy development that could benefit eelgrass on a Sound-wide basis. TMDLs in many areas are based on outdated information and need to be updated. I don't know much about the impact of these things, but in general, policies should curtail degrading environmental conditions—for eelgrass and all other marine life. Leading/biased question. see also comment to 4a Discharge permits can be adapted to protect

eelgrass from known contaminants. Again, I'm not sure of specific policies - just seems that protecting eelgrass from degrading environmental conditions would protect and/or enhance Puget Sound eelgrass. Common sense answer. Stormwater pollution continues to be a factor contributing to declines in eelgrass and the overall health of Puget Sound. Policies that enhance protection of the Sound from stormwater pollution appear necessary to improve water quality. Some improvement can occur from policy change related to these items. Increase restrictions on property owners and boat owners. Something has to be done about mapping and treating stormwater inputs to Puget Sound. Unregulated use of fertilizers near streams and other water bodies. This is a positive for most species in PS. My sense is that heavy sediment loads could present a problem for the growth of eelgrass, as it needs the light. If there is enough current, this may not be a problem, but in some situations, a heavy sediment load and low wave energy may cause loss of eelgrass beds. I have much less information and/or understanding of the matters of water quality on eelgrass. Ulva mats can shade out eelgrass, and presumably nutrient inputs stimulate Ulva and other macroalgae growth. I'd guess nutrient loading would be a significant contributor to eelgrass habitat degradation. Buffers on fertilization application adjacent to waterways could reduce nutrient input. Stronger enforcement capacity in city, county, and state agencies would help. Yes along with no the building restrictions listed above, it will depend on enforcement and compliance protecting water quality would help the entire Puget Sound ecosystem. As long as there is scientific evidence that supports the policy change. Less sure about this question. Wouldn't decreasing nutrient load actually decrease eelgrass? We need a clear mandate of how to protect the eel grass and accurate maps depicting the locations of existing protect habitat and the location of potential eelgrass restoration sites, so they can be preserved rather than developed. State and local department of health onsite sewage disposal programs Local government regulations for stormwater and onsite sewage disposal programs and vegetative buffers Department of Ecology regulations for outfall discharges. These effects are wide spread and have a substantial effect upon light reaching the bottom. Too many nutrients entering Puget Sound. Causes large micro algae blooms which block sunlight. Also causes macro algae to proliferate which then accumulates in large piles of seaweed on top of eel grass smothering it. See water quality answer in previous. I do not have specific knowledge of Washington State shoreline policies and cannot provide specific examples of which policies need to be changed. However, I am confident that the suggestion above provides a logical and feasible alternative that may enhance eelgrass in the Puget Sound. See above for N. For sediment (and N) loading restore watershed vegetative filters in the upland. NPDES permits essentially have no bar for approval, and allow for the discharge of extremely high loads of toxins and contaminants in areas. Part of this comes from Washington Department of Ecology operating under delegated federal authority from the EPA, but not consulting on the effects of their permits under the Endangered Species Act. There is also very little regulation of agricultural discharges that can easily overload the processing capabilities of eelgrass and cause losses. Regulation needs to be improved and consistently applied. Shoreline protection measures and enforcement of building codes need to happen. Water quality requirements for nutrient and turbidity inputs need to be revised and enforced. Again, I'm not super familiar with the policies but it seems obvious to me that if you improve water quality you improve eelgrass beds. It would be nice to see more encouragement to restore other native species such as Olympia oysters - these help improve water quality for other species like Z. marina. So maybe more policies could look at protecting the entire ecological system and not have such a single-species focus. again, it all depends HOW policies are changed (poor wording for the Q) Avoid ballast water discharges in Puget Sound, avoid boat sewage releases into Puget Sound At least in other places, strong eutrophication has been associated with eelgrass decline. in-stream and riparian activities that contribute to sediment loading need to be additionally considered Easier access to sources of pollution such as farms. A two-pronged policy for dealing with nutrient loading from leaking septic: 1) incentives to get home owners to repair/replace/remove leaking septic; 2) enforcement when home owners refuse to address the problems their causing. It is possible that poor water clarity inhibits eelgrass growth in South Puget Sound. In addition, outfalls may inhibit eelgrass establishment in certain areas. Certain nutrient loading may actually promote eelgrass growth if the component nutrients are absorbed into submarine soils. Nutrient loads that promote algal blooms would result in reduced transmissivity of light and have deleterious effects. This is such a generality, I do not have specifics except that areas with poor water quality do not support healthy eelgrass beds (example inner Dungeness Bay, where ulvoids flourished in place of eelgrass). Clearly eelgrass beds require healthy environmental conditions to survive (good water circulation is probably most critical). Nutrient loading from WWTPs needs to be stopped using tertiary treatment, and nutrient and sediment loading from stormwater needs to be entirely curtailed, first by restrictive shoreline development regulations and regulations requiring acceptable practices for living along the shoreline and in the watershed that control nutrients at the source. Water quality degradation is probably the single biggest factor influencing Z marina, especially as it relates to underwater irradiance. Propagule limitation and light limitation likely result in the slow recolonization of Zm. Don't know MNY understanding is that water quality with reference to sediment and nutrients can be a problem if the end result is to reduce the light penetration to the plants Labor Day weekend 2013, following an intense rainstorm a few days prior, there were large rafts of lawn clippings and other residential yard debris floating in Puget Sound off the Edmonds shoreline. We need to keep our crud out of our waters. see 4a Impact of railroads For instance, the present No Discharge policy/regulation, if imposed and enforced with significantly reduce the effect of excess nutrients, pathogens, and other anthropogenic contaminants. Hopefully (hence the yes), but I'm not sure how effective policy would be since a lot of environmental conditions are affected by nonpoint source pollution, which is hard to regulate without banning the substances. Harmful algal blooms have become more common as a result of nutrient loading. When these things settle out they bury plants. Point sources must be improved such as sewage treatment plants and onsite sewage systems. But only if enforced. Currently, most jurisdiction allow activities that will impact eelgrass (SMP and CAO). WDFW also allows and so does the Corps and the Services. They all require mitigation; which in many instances does not work. society needs to decide; it is not a technical or scientific question anymore. Amending HPA legislation for shoreline armoring; expanded water quality standards for NPDES permits; stormwater management/LID. Yes means that I believe so. We won't really know until we do a better job of doing basic research to better understand marine systems, in addition to monitoring the effects of stressors. I am a Canadian and do not know the details of US policies only that they need to be updated to protect eelgrass. IF changes mean improving, then reducing sediment load would enhance eelgrass Lack of attention to sewage outfall is an issue. Autumn upwelling is bringing nutrients to the surface, potentially leading to localized eutrophication. In fact, nutrient on the whole is ignored. Shoreline master plans. Substantial fines for landowners who disregard regulations (see San Juan Journal article on shoreline clearcut 2/19/14 - owner fined \$3K). This does not dissuade such landowners from doing these devastating practices. These policies already exist, including the Clean Water Act and Shoreline Management Act. Same as above only apply to above statement. more stringent water quality policies which reduce eutrophication will reduce competition with non-native vegetation (ulva) and have beneficial impacts to more than just eelgrass Removing

shoreline armoring Residential exemption from the Shorelines program encourages increased development and septic system installation proximal to Puget Sound. Single family residences should be conditional use. Change all of "shoulds" in SMPs to "shalls". Again, I think the policies are in place and the approach should be incentivized. Good steps are currently being implemented by the City of Seattle to increase on-site infiltration rates, minimize impervious surfaces, and reduce surface runoff. Having this law in place gives abutting private property owners the sense of entitlement to have a private recreational dock or a mooring buoy. Enforcement of current water quality policies should adequately protect eelgrass from poor water quality, sediment loads and excessive nutrients. Lack of enforcement will not. DOH pollution identification and correction program supports local health jurisdictions to manage and fix failing onsite sewage systems and other sources of nutrients to the marine environment especially in areas adjacent to shellfish growing areas. These programs are supported by NEP funding which is rapidly declining. Policies that support ongoing funding of PIC programs are essential for nutrient management. Also, many local jurisdictions can use solid waste and other land use ordinances to manage nutrients. However, they may not have the political will to do so. Any state policy that encourages local governments enforcement using their existing ordinances would be helpful - although I dont know what that looks like. I don't have specific examples as water quality regs are not my area of expertise. But overall, improving water quality conditions provide a multitude of benefits including for eelgrass. This is obvious in that continued degradation of the environment will impact the eelgrass, but it is harder to point at specific actions. Again though, the two primary components to protect against are increased attenuation of light and eutrophication. Requiring treatment of stormwater and inputs to surface water drainage that have high nitrate levels. See above Everything our State is already doing to address this will help, however, education of our communities is what will have a larger impact as we each start making behavioral changes in our lifestyles. It would seem so. There need to be more studies, more attention focused on this by Fisheries and DNR scientists. AT this time, it appears that the commercial interests are dominating the conversation. Beaches with rebar, wire, nets, dredging, barges, rafts, will not enhance the native species or the balance for a healthy ecology as we go into the future with increased population. Scientists know what kind of armorment (bulkheads) are less harmful. These should be required. No more flat cement bulkheads. Overall, policies that reduce water pollution will benefit eelgrass presence by avoiding stress to the plants. Policies requiring consideration of stormwater treatment and outfall siting are the ones that come to mind. These are very broad categories. Changing the impacts of any of them will produce some positive changes. However, they will produce little net change for the fate eelgrass if they are not more specifically defined. We can't be sure but cleaner is always better The 1972 Clean Water Act called for an end to new point source discharges. So many judges and hearing examiners ignore this until activists make it impossible to ignore. As for nonpoint pollution, our floods this week show how much silt and debris is routinely washed into the Sound. Fishermen, developers, home owners, gas stations... we all need to be aware of our daily actions with the potential to degrade water quality and increase nutrient and sediment loading. I spent years of my life trying to convince METRO of this in Seattle and Fort Lewis of this in Pierce County. Frustrating! Allow natural flow of sediments in the nearshore environment to maintain proper substrate for eelgrass through a policy of promoting hard armoring only in extreme instances, and concentrating on education and soft-bank protection I believe we just need to FUND enforcement of existing environmental laws regulating the nearshore. I think the largest benefit would be to identifying illicit discharges and other water-quality-type infractions (e.g., using chemical fertilizers within the shoreline buffer), but better enforcing shoreline development regs in general, might also improve conditions (it definitely would for other types of habitat like forage fish spawning, etc.). see above possibly, but these are long-term issues that are hard to pinpoint Not sure

4c. Will changing policies that require greater project compliance (e.g., larger mitigation ratios, higher transplant success criteria, and longer monitoring periods) enhance eelgrass in Puget Sound?

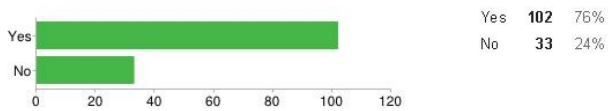


If YES, please explain and provide an example of policies that need to be changed.

For this question, consider the benefits of fee in lieu approaches that allow for targeted mitigation actions. Policies need to take into account the proliferation of geoduck farming and other shellfish aquaculture. test Provide comprehensive science and management practices to allow existing policies to be revised such that compliance can be included in a way that supports adaptive management at both a site and regional level. If/when mitigation via transplantation or enhancement of eelgrass beds is to be approved then yes, all of the above examples should be improved. - Extensive monitoring required for multiple years (possibly 5-10?) - Larger mitigation ratios and higher transplant success criteria should be required as there are still many variables, unknowns and issues with transplantation/supplementation. All needs to be required to ensure that the mitigation actually worked! Yes to enhancement, but missing the point on balance of built environment. Requirement for mitigation must be linked to provable project effects, not just general policy If HPA conditions regarding impacts to eelgrass were actually enforced, many projects would have less impact and eelgrass resources would significantly benefit. I am not well versed on any specific policies but I think that if you are enforcing a policy that protects eelgrass, than eelgrass will be enhanced. better control of moorage buoys These changes would likely increase the success of target restoration areas. Potentially, especially if we can monitor these mitigation projects long enough, and in a scientifically valid way, to learn something from their implementation that improves the chances for success for the next project. I wish there was a "maybe" for an answer because that is what I would have put. Longer monitoring programs never guarantee the success of a project... maybe the larger mitigation ratios would? I think that proper site selection for mitigation is critical leading/biased question. see also comment to 4a Same as above. Mitigation should be common place for individual development projects. Most regulators do not realize that mitigation is possible for these kinds of impacts. Most projects are not now required to mitigate fully or effectively. Knowing where (and how) that mitigation will be effective might lead to more reliance on mitigation, or requirements to do so. Certainly improved monitoring will allow for learning by doing, meaning we will determine which strategies work best on different conditions I believe that current mitigation ratios, or other mitigation measures are

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For this question, consider the benefits of fee in lieu approaches that allow for targeted mitigation actions. Policies need to take into account the proliferation of geoduck farming and other shellfish aquaculture. test Provide comprehensive science and management practices to allow existing policies to be revised such that compliance can be included in a way that supports adaptive management at both a site and regional level. If/when mitigation via transplantation or enhancement of eelgrass beds is to be approved then yes, all of the above examples should be improved. - Extensive monitoring required for multiple years (possibly 5-10?) - Larger mitigation ratios and higher transplant success criteria should be required as there are still many variables, unknowns and issues with transplantation/supplementation. All needs to be required to ensure that the mitigation actually worked! Yes to enhancement, but missing the point on balance of built environment. Requirement for mitigation must be linked to provable project effects, not just general policy If HPA conditions regarding impacts to eelgrass were actually enforced, many projects would have less impact and eelgrass resources would significantly benefit. I am not well versed on any specific policies but I think that if you are enforcing a policy that protects eelgrass, than eelgrass will be enhanced. better control of moorage buoys These changes would likely increase the success of target restoration areas. Potentially, especially if we can monitor these mitigation projects long enough, and in a scientifically valid way, to learn something from their implementation that improves the chances for success for the next project. I wish there was a "maybe" for an answer because that is what I would have put. Longer monitoring programs never guarantee the success of a project... maybe the larger mitigation ratios would? I think that proper site selection for mitigation is critical leading/biased question. see also comment to 4a Same as above. Mitigation should be common place for individual development projects. Most regulators do not realize that mitigation is possible for these kinds of impacts. Most projects are not now required to mitigate fully or effectively. Knowing where (and how) that mitigation will be effective might lead to more reliance on mitigation, or requirements to do so. Certainly improved monitoring will allow for learning by doing, meaning we will determine which strategies work best on different conditions I believe that current mitigation ratios, or other mitigation measures are

quite inadequate because they do not allow enough for uncertainty and are usually only focused on a narrow range of attributes (or single attribute), with little or no monitoring. Site specific as to the success. Surrounding eelgrass beds and shoot counts, etc. Many variables to be considered. I think the emphasis here should be on longer monitoring windows and flexibility of contractor to adapt to site conditions (adaptive management). No. Mitigation, enhancement and transplant has no chance of success without water quality. If you have decent water quality, then there really is no need to mitigate because eelgrass is prolific on its own. Monitoring periods are far too short and too often proponents keep transplanting additional eelgrass and then claiming compensatory mitigation success. all of these would enhance eelgrass if there required more compliance. but should be balanced with cost to project managers. I'm hoping that policy changes that require things like larger mitigation ratios, higher transplant success criteria, and longer monitoring periods would enhance eelgrass. I do not have specific knowledge of Washington State shoreline policies and cannot provide specific examples of which policies need to be changed. However, I am confident that the suggestion above provides a logical and feasible alternative that may enhance eelgrass in the Puget Sound. This would not be needed if (4)(a) is met. We would need to change laws and not policies to not allow impacts to eelgrass unless it is for the greater public good. Residential docks are a water-dependant use. Most residential property owners could not or would not pay the true cost of replacing eelgrass lost from shading, shell hash, and vessel props. If impacts are allowed then we need to require greater project compliance including performance bonds. Conceivably. Although the primary goal of mitigation is to offset losses from impacts. Thus, a fundamental metric of effective mitigation is no net loss, not enhancement or gain of area or function. Maybe since in some areas eelgrass populations ebb and flow depending on the year. The transplanting work/methodology needs fine tuning. your question is a bit contradictory - as I explained above, there needs to be more emphasis on compliance - not necessarily "larger mitigation ratios", but more attention on follow through. If a project is required to do mitigation work, make sure it gets done and is successful - so longer monitoring periods may make sense. I will caveat this answer with lets try to first not harm what we have but if habitats need to be influenced mitigation should be monitored to ensure you are getting your goals actually meet though mitigation. Larger mitigation ratios will make avoidance a more preferred option than it is now. Avoidance is the only way to protect eelgrass. While it is possible to plant eelgrass, the sites that should have eelgrass do have eelgrass or there is a reason why the habitat conditions have changed. Higher mitigation ratios won't overall produce more eelgrass sites. Requiring higher mitigation ratios and increased success criteria would benefit eelgrass; however, statutory limitations require mitigation to be proportional to impacts and may restrict monitoring to the timeframe of a permit. The State and local jurisdictions need to be prepared to say no, to deny application that unnecessarily impact eelgrass. Next the mitigation needs to be actively monitored and enforcement action taken if the project is not in compliance. possibly, the devil will be in the details. No one is adequately monitoring the impacts of commercial aquaculture activities. We need to move responsibility away from DNR and implement a system similar to California's shoreline management program. ...but may depend a lot on the suitability of the mitigation site to support eel grass. Mitigation projects must have stronger documentation of their success and reasons for failure. Long-term monitoring is necessary and should be required. An analysis of restoration success should be used to adjust ratios and success criteria. HPAs need a longer lifespan (than the current 5 year limitation). At the sites I dive, it's hard to tell if the policy itself or the enforcement of it is to blame. I have only secondary knowledge, but a major issue in freshwater mitigation sites is that "long-term monitoring" usually means 1 year later. Longer-term monitoring, on the order of 5-10 years is better, although I recognize harder to require. failure to monitor is a problem that needs to be addressed. Policies that allow destruction of eelgrass in exchange for transplanting eelgrass to a new site often do not take into account failure rates due to conditions that prevent eelgrass from surviving in the mitigation site. Requiring greater assurances of success should be required in all projects likely to damage existing eelgrass beds. Don't know. Larger mitigation ratios, higher transplant success criteria and longer monitoring periods. Better monitoring data can always be put to good use in developing more comprehensive, flexible policies. Puget sound residents should have to avoid eelgrass. Jumping to compensation for impacts to eelgrass is not sustainable given that we have no real quantification for compensation ratios that are proven and given that most transplant projects fail to reach their designed goals after 5 years. Avoidance is the best deterrence to impacts. probably --- but at some point you will need to overcome the lack political will. Increasing longer monitoring periods and success criteria is key. It's easy to plant eelgrass, it's tough to make sure it sticks around. I don't know what policies are on the books now. I have only learned about the importance of eel grass in the past 5 years. Because I have some of the species on my beach, I feel very protective of this grass and will check it out when the tides are low in late spring and hope it is still healthy. It is my understanding that DNR scientists will be watching it. Transplant is an iffy proposition at best, mitigation should consist entirely of rehabilitating areas that used to support areas, such as placing clean sand on beds degraded by log storage, for example. Mitigation should also be strictly done in advance, with banking if necessary, as survival of planted eelgrass has proven to be pretty abysmal over the years. I don't know. The big impacts are relatively well managed at the moment. I think the larger benefit will be from identifying those who illegally impact eelgrass beds through their (often small, ignorant) actions. Puget Sound is struggling because of many paper cuts, not large stab wounds. Don't have adequate background/knowledge to provide details. There is not button for yes and no or maybe. Yes, this might have positive effects if the funds to do so are expended primarily on urban or highly developed sites where there is a low probability of recovery. It is also a bad idea if the funding diverts dollars from other more critical restoration activity. For example, restoring habitat in estuaries can have positive effects in Salmon recovery. However, the same dollars spent on near shore habitats can produce some good but does so at the expense of restoring more important freshwater rearing and spawning habitat. The dollars for this kind of work are limited and become more so with each passing year. It appears to me that digging up eelgrass in one shellfish harvesting season leaves large gaps in the coverage that continue through the next year, at least, if not longer. So I don't think a one-year out monitoring would be adequate to gauge the true success of restoration. Often times it's difficult to find areas for mitigation ratios higher than 1:1 or 2:1, so increasing the mitigation ratio isn't the answer. Transplant success criteria and monitoring period (5-10 years) is already pretty good. Monitoring is the big issue here. Not nearly enough is being done and the the DOE, due to lack of State funding is not even attempting to conduct a coordinated on-site monitoring program to measure the results of changing policies in SMP updates. The situation is pitiful. As far as I know, no agencies (in particular the Corps of Engineers, NMFS) have meaningful systems to conduct post project evaluations themselves in order to verify have been completed, and instead rely entirely on self reporting by applicants/agents, which often does not occur. I'm not sure changes are necessary, but larger mitigation ratios would logically enhance eelgrass. Restoring habitat conditions to those that support eelgrass should be the first priority. Where eelgrass does not return either through natural recruitment or transplantation into the disturbed area, it might be good to have an option for paying into a restoration fund. However, this would only work if there is an adequate supply of suitable sites available for restoration. Same as above - not

familiar with current policies but it makes sense that greater compliance would be more protective of habitat. Discourage lawns; encourage backyard habitats. Discourage asphalt; encourage low impact development. permitting staff need to be educated, enforcement presence Monitoring requires staff time to ensure we achieved>NNL. For people like me, the area habitat biologist, who was told to get the most mitigation you can and issue a permit with monitoring...We are not able to continue issuing 150 permits a year/person and monitor past projects. Monitoring needs to be done and reported to a separate reviewer or program. Then if it fails it needs to be redone or the reason mitigation was needed needs to be removed/restored...fat chance. Expanded monitoring at mitigation sites would hold people accountable to achieving functional outcomes. I am assuming these policy changes will help, but I do not know that for sure. I need more information in this area. How about don't know? need better avoidance criteria long term monitoring policies with adaptive management that requires replacement if no success after 5 years I do not deal with compliance regulations so I do not know see above Enforcement is the key here. If proponents of a project are asked to provide mitigation, compliance will need to be verified.

5a-e. Do you know of any areas in greater Puget Sound (Neah Bay east and south of Pt. Roberts) where eelgrass once grew? If so, where and what in your view is preventing it from growing there now? Please share as much location information in the text box for each area below (location name, GPS coordinates and any stressor abatement activities that need to be performed prior to eelgrass transplantation).

In south Puget Sound, there are many places where oyster shells and Ulva have eliminated/are preventing eelgrass recolonization. Not sure if specific location are discussed here, but take a look:
<http://www.trpc.org/regionalplanning/environment/Documents/MarineShorelineSedimentSurveyandAssessment.pdf> no Commencement Bay. Areas along Ruston Way Sorry, nothing is immediately coming to mind. I've only been in my position for five years and while I'm a fisheries biologist, I do not work with eelgrass so I am not familiar with historical beds in the area. No, but I'm sure there are plenty. no specific confirmed sites I do not. Port Gamble Bay former mill site, Remove large amount of fill and over water structures, wood waste clean up, under a soon to be MTCA clean-up action. don't know There appears to be an abundance of eelgrass along the Strait of Juan de Fuca, Sequim and Discovery Bays and Hood Canal. Stressor abatement should be considered for large urban areas first. I am now wishing I had kept more extensive notes on my dives! I already mentioned Dungeness Bay. Also area within Freshwater Bay had more extensive eelgrass (and larger kelp beds as well). West side of Protection Island once had more eelgrass, out as far as 20' depths, but that has degraded over the last decade (based on original geoduck survey data in late nineties). I do not have specifics within Port Townsend Bay, but planners there instituted a "no anchor" zone adjacent to the downtown area, designed to improve eelgrass there. don't have knowledge No Only by hearsay. I have not been in Washington long enough to have personal experience on this topic. n/a Many. Not from personal observations - just from existing literature. Wish I knew sorry, I don't have specific examples South end of Sequim Bay to the west of the mouth of Jimmycomelately Creek. Diving surveys in July 2013 documented that eelgrass is naturally recolonizing this area following the cessation of decades of dredging & log rafting. Westcott Bay is the obvious example, but everyone knows about it already. It is well documented. I can't think of any others off hand. test Point No Point. I believe that freighter wakes at low tides are scouring eelgrass and impeding recovery. The sandflats had abundant eelgrass within the last twenty years - it's changed significantly. Don't know. none Most of my knowledge is based on Battelle projects conducted with Ron: Eagle Harbor, Clinton ferry, Lincoln Park, Port Townsend, Fox Island, Sequim Bay, etc. I would recommend digging through all the old HPA files for still more locations. Don't know Sorry, I don't have any specific situations to cite. Poor water quality, leading to algae blooms that occlude sunlight, are the largest stressor on eelgrass, and so pretty much everywhere in Puget Sound eelgrass never grows as deep as it once did. This occurs everywhere in Puget Sound and is directly related to human-caused eutrophication. My understanding is that eelgrass once grew in much greater densities in Westcott and Garrison Bays along northwest San Juan Island. My understanding is that substantial inquiries into the source of the decline have proven inconclusive. Photographs of Fisherman Bay on Lopez Island also suggest that eelgrass may have grown under and near areas that are now covered by overwater structures. I have not been working in the area long enough to have this historic context personally. None specifically. It appears that over long periods of time measured in decades that eel grass presence and extent has been highly variable. I don't know directly, but have heard a lot of discussion around this topic. For example, I've heard that aerial coverage of eelgrass has declined in Similk Bay in Skagit County (48.437249, -122.563657) and is thought to be due to poor water quality from Hwy WA-20 runoff and lack of effective water filtration in the area. I've seen changes in many parts of Puget Sound, but have not directly monitored any of the sites where I've observed changes, so don't know if it is natural or not. Within the last two years, I have seen much higher densities of eelgrass throughout the Puget Sound, than noted before. No, I am currently not in the field. Drayton Harbor

5a. North Puget Sound and Strait of Juan de Fuca

test no Ediz Hook. It is not growing there because the sediment is altered by bark and wood debris originated from log booms. I've only been in my position for five years and while I'm a fisheries biologist, I do not work with eelgrass so I am not familiar with historical beds in the area. * Redundant don't know NA Port Angeles, principally along Ediz Hook in areas covered by bark and debris from historic log rafting. Westcott Bay, San Juan Island. Unknown. A site on NE Blakely Island (San Juan County) was impacted by a landslide following failure of an old culvert. A sand deposit washed over and smothered the eelgrass about 8 years ago. Since then, the sand has been transported down the shoreline and eelgrass is repopulating the original site. I am not sure if the sand moving longshore has impacted subtidal eelgrass or not, as I don't have "before and after" data. Westcott Bay and Garison Bay (San Juan Island). Not familiar with the details of why or what is preventing. In the last 10 years, eelgrass has exploded in the North Puget Sound and Straits. It is growing higher on the tideline and in greater densities than ever before. Don't know. none Don't know How's the Cherry Point area these days (Whatcom County, Georgia Strait)? It used to be a prime area for spawning herring. There are 2 refineries and Intalco located at Cherry Point and a proposed coal bunker. East side of Point Roberts. Herring used to spawn there in the 90's, not any more. I already mentioned Dungeness Bay. Also area within Freshwater Bay had more extensive eelgrass (and larger kelp beds as well). West side of Protection Island once had more eelgrass, out as far as 20' depths, but that has degraded over the last decade (based on original geoduck survey data in late nineties). I do not have specifics within Port Townsend Bay, but planners there instituted a "no anchor" zone adjacent to the downtown area, designed to improve eelgrass there. I suspect there have been changes

to sediment transport processes that have reduced the importation of finer materials being deposited in these areas. Port Townsend I suspect is from repeated disturbance associated with pleasure craft anchoring near downtown. Ferry dock may have had some impact as well. Many eelgrass beds in the San Juans have disappeared over the last few years, especially in embayments. Westcott Bay is an example. No anchoring requirements in eelgrass zones for all areas will allow any transplantation to have the best chance for survival. Bellingham Bay likely had much more prior to all the shoreline development of the last 150 years. Useless Bay

5b. Saratoga - Whidbey Basin

test no I've only been in my position for five years and while I'm a fisheries biologist, I do not work with eelgrass so I am not familiar with historical beds in the area. " Holmes Harbor near the southern end. Nichols Brothers Boatworks construction impacts are the most likely cause of eelgrass decline there. don't know Amsterdam Bay NA In Similk Bay, there is a good size eelgrass bed along the shorelines. Past surveys have shown a decline in the size of those bed, that might be attributed to run off from failed septic systems, nutrient run off from the golf course at the head of the bay, and efforts to control spartina (contact with noxious weed control does not support this, however timing of declines is suspiciously coincident with declines). A further surveys and a study is needed to try to determine whether eelgrass beds are recovering or still in decline and to determine why. Eel grass still growing strong on Possession beach where I grew up Probably more grew in Pt Susan, but it has been accreting for decades, so it is hard to prove anything. Saratoga Passage has excellent eelgrass beds and is in need of no enhancements. Don't know. Don't know Mukilteo boat launch Saw a die-off at south end of Holmes harbor 2007-08. Bed has recovered and very robust. Z.japonica now present which I do not recall from earlier years.

5c. Central Puget Sound

test no I've only been in my position for five years and while I'm a fisheries biologist, I do not work with eelgrass so I am not familiar with historical beds in the area. " don't know NA Good eelgrass along Marrowstone Island. The extent of eelgrass south of that is unknown to me. Dyes and Sinclair Inlets; Liberty Bay Don't know. none Don't know Warsinske 50' by 50' dock on the south end of Bainbridge Island. Blake Island Marina- Remove and put pier into access. Kingston Ferry Terminal and marina

5d. South Puget Sound

test no I've only been in my position for five years and while I'm a fisheries biologist, I do not work with eelgrass so I am not familiar with historical beds in the area. " don't know NA Lynch Cove Eelgrass was once present in large sections of the Nisqually estuary. It seems that over-active geoduck harvests have eliminated much of it since 1998. Don't know. none Zangle cove Your department identified a patch of eelgrass in Zangle Cove a few years ago. I believe the eelgrass is still there and hope the department is working toward full recovery of eelgrass in this area. We really appreciate the fact that your department took a serious interest in this particular spot related to eelgrass. You are to be commended for this. Only in Zangle Cove in the south sound. DNR scientists have photographs and coordinates. This is being watched. I live and work in Nisqually where the largest southernmost bed of eel grass exists. A paucity of eelgrass here. I suspect nutrient loading leading to impaired visibility in the water column causing deleterious effects. I notice the acceleration of residential waterfront development over the last 20 years in this area.

5e. Hood Canal

test no Port Gamble, again in areas degraded by log rafting. I've only been in my position for five years and while I'm a fisheries biologist, I do not work with eelgrass so I am not familiar with historical beds in the area. " don't know The Hoodspout area seems to be greatly affected, though I don't know what the exact stressors are. Areas in Hood Canal the pier's are blocking the light and preventing eelgrass from growing. Don't know. none Don't know Good eelgrass here. Port Gamble Bay Aquaculture structures in Quilcene Bay along east shoreline South Hood Canal in Anna's Bay. 20 years ago the entire bay was a lush eelgrass bay adjacent to the Skokomish Delta estuary. One of the stressors I have noticed is DFW and State Parks (Pottlatch State Park, Twanoh State Park) allow recreational clambers to dig in the existing eelgrass beds. This practice should be discontinued and monitored. yes, fine sediment loading, coarse sediment transport have been negatively influenced

5e. Hood Canal

test no I've only been in my position for five years and while I'm a fisheries biologist, I do not work with eelgrass so I am not familiar with historical beds in the area. " Redundant don't know Don't know. none Don't know yes, fine sediment loading, coarse sediment transport have been negatively influenced

Any additional information to improve eelgrass restoration and conservation in Puget Sound?

no If the governmental agencies entrusted with protecting eelgrass placed a greater emphasis on eelgrass conservation than on issuing permits for activities likely to harm eelgrass, it would improve eelgrass conservation. When a shoreline permit is challenged, it has been my experience that officials for the Washington Department of Fish and Wildlife are more likely to testify on behalf of permit applicants than on behalf of the public resource. To the extent this approach continues, I believe it will be difficult to improve eelgrass conservation or restoration. In addition, agencies like the Department of Fish and Wildlife currently allow new project impacts in exchange for removal of applicants' existing unpermitted activity. While enforcement of unpermitted activities might limit the number of "restoration" projects available to allow new impacts to eelgrass, it likely would improve eelgrass conservation. Simply transplanting eelgrass from donor beds will not increase the area of eelgrass. The factors limiting production at a given site need to be eliminated or

minimized to ensure long-term viability of the restoration. information Transplanting eelgrass is great fun. The areas around the Rosario Beach Marine Laboratory (Fidalgo Island) have very nearly the identical eelgrass cover they had 40 years ago. First, remove invasive species, such as japonica, that are robbing resources necessary to support Marina in its natural habitat. Second, it's not possible to force more Marina to inhabit Puget Sound. Natural climate condition cycles will dictate where Marina can exist. Identify these areas and assure invasive species are not out competing Marina. The goal is to provide habitat, thus encouraging activities that help provide that habitat is an essential part of any restoration program. Need a campaign to improve PS water clarity. More of a discussion on how the State would like resource managers to deal with Z. japonica. Welcome it? Protect it? Get rid of it? I think a larger effort should also be put into the efforts of education. In nisqueally we have a growing number of people who understand the importance of eelgrass and have also assisted the center in creating a 15k acre DNR Aquatic Reserve around these critical habitats along side many others that are connected to the health of the Puget Sound. No. Eelgrass grows very well in complex communitites of other organisms that provide nutrients to the plant, such as shellfish beds. Areas in other parts of the state where there is abundant shellfish there is also abundant eelgrass. The relationship is co-beneficial Thanks for the opportunity to comment. I've been involved with eelgrass protection, mitigation, restoration and monitoring off and on since the early 1990's and I see that it remains as important an issue now as it ever has been. Please keep me informed of your work in this area. Require no anchor zones in San Juan Island to reduce eelgrass degradation. What elements make a good eel grass environment? Given that I am not sure except from what I have seen, and given where I live, I would encourage different Counties to be more focused on septic compliance along shoreline residences. This is probably a more localized effect, if any. Limit shoreline development and runoff pollution (not sure if the latter is a significant issue with respect to eel grass ecology) Set up mitigation banks that will allow for structures to be removed and get credit for removing them. So many derelict structures sit in the water falling apart because people are hesitant to remove them because they will loose the mitigation opportunity. monitoring restoration efforts and protection of existing beds for rate of change plus or minus. When barges come into shore to deliver materials to armor shorelines, and sit on the substrate at low tide, they are suffocating whatever is beneath them, which can often be eelgrass, as well as invertebrates. It is very discouraging to see these barges sitting for up to 10 days at a time, destroying the underlying environment. I wish they were not allowed to be on the shoreline, but would have to move in and out with the tides so as to protect the substrate off of the shore where the armoring is being done. Again, if there were better information on likely transplant or mitigation sites, then agencies would probably be more willing to require full and effective mitigation. Right now it's not always considered a viable option. Hopefully we can talk about this at the Salish Sea conference? More aggressive and proactive Dept. of Ecology oversight of the implementation of local Shoreline Master Programs. The influx of Z. japonica may be a cause for concern An educated guess (without science to support it) is that the quickest fix would be to ban the use of residential use of herbicides by home owners and lawn and landscaping services. This would also be among the most politically difficult to accomplish. Better understanding of the light environment at the restoration sites. More education programs in schools. Mandatory education of fishermen before a license can be purchased. No more oil or coal shipments through the sound. Elimination of nearshore dredging sites. Full on placement of mooring buoys where practical. required no anchor zones where feasible There is a need for a discussion regarding Zostera marina and restoration of the native oyster Ostrea lurida. Eel grass currently occupies several thousand acres of tidelands historically occupied by extensive beds of the Olympia oyster. Achieving native oyster restoration in Puget Sound would require restoring those historic intertidal habitat features between -3.0 to +1.0 feet MLLW in Zostera rich embayments such as Samish and Padilla bays. Absent the ability to do so O. lurida restoration will not be achievable in Puget Sound. I think that Puget Sound Partnership Leadership Council was wildly fanciful in setting their eelgrass restoration goal, and as such it might not be reasonably attainable. Climate change may increase the abundance of eelgrass throughout Puget Sound through increased CO2 and subsequent increased growth rates (or potentially lead to large losses from disease or other causes). Other than reducing pollution and disturbance, I don't believe there is much else we can do economically to increase eelgrass abundance. I find this survey to be remarkably biased in favor of mitigation, and restoration as a tool for eelgrass recovery. These efforts are a waste of time if you don't address water quality. Also, shellfish aquaculture enhances eelgrass growth, yet it is only offered here as an impact. Your "impacts" are all taken as negatives, when the opposite is true, climate change and shellfish aquaculture have a net benefit on eelgrass. You fail to identify shellfish farmer and fishermen in the first question, when these are the people that are on the water everyday and have the greatest knowledge of what's going on. I indicated "poor" on question 2. so don't feel qualified to continue with stressor questions. This raises an important question for your survey analysis. Will you weight the answers of the (self-reported) 'knowing' higher/greater vs. the 'unknowing'? In social science surveys of resource systems, experts often rate themselves as knowing less than the un-knowing as they recognize a broader range of knowledge potential while the less-knowing can have naive assumptions about stressors, but check buttons with great conviction. How would you validate a responder's knowledge in an objective way? It doesn't seem that any questions here offer insight as to respondent knowledge base. Synergy with neashore forage fish habitat Education. Need to know where it is and understand why it's important if you want people to care about not putting their anchor or mooring buoy in it. WDFW has a potential wealth of data (presence/absence) in the back up files for HPA permits associated with docks permit applications in Puget Sound. Funding someone to mine the permit files to extract that data and create a comprehensive database could be an interesting endeavor. stop oversimplifying the stressors. Look at beneficial reuse of dredged material as a mandate, much of the material going into open water disposal could be used to restore and improve bathymetric conditions for eelgrass. Several beach nourishment projects have been shown to improve eelgrass range and density, but are heavily regulated and tied to onerous monitoring, while single family bulkheads have the opposite impact and are exempted. Stop the aquaculture industry from spraying to control Z. japonica, or other eradication methods, which are likely to result in damage to Z. marina and other marine organisms. Similarly, prevent other modifications (aquaculture or other alterations - i.e., any activity that will likely exclude eelgrass) where eelgrass does or may occur.

Contact information? (optional)

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