

The Worth of Blue Carbon: A Knowledge and Values Assessment of Conservation Policy Stakeholders in the Pacific Northwest U.S.A.

Executive Summary

Tidal wetlands are recognized for their important role in sequestering carbon dioxide. Carbon dioxide is a greenhouse gas and major contributor to global warming. Carbon sequestered in tidal marshes is known as *blue carbon*. Its value is of great interest to those developing climate change adaptation and mitigation strategies, including carbon markets, around the globe. Not enough is known to estimate the amount of blue carbon that is stored in the salt marshes of the Pacific Northwest region or to compare how rapidly new sequestration occurs – for example, through wetland restoration—or how the rates compare with forests, agriculture, and other land uses. Nor is there enough information to determine whether or how regional climate or conservation policies might be adopted or adapted to increase blue carbon as an additional incentive for conserving and restoring tidal wetland habitat.

The Pacific Northwest Coastal Blue Carbon Working Group represents scientists, managers, land stewards, educators, and communicators, representing state and federal agencies, native sovereign nations, and conservation and research organizations. The group considers the development of blue carbon policies important, needed, and likely to benefit society by reducing the accumulation of greenhouse gas in the atmosphere, and providing an additional incentive for conserving and restoring tidal wetland habitat. To help inform policy makers, the group initiated a three-year study to quantify blue carbon in the salt marshes of Washington and Oregon.

To help the group understand what types of information will be most useful to policy stakeholders, at the outset of the project (July 2017), the South Slough National Estuarine Research Reserve reached out to 129 individuals whose work in natural resource management or habitat restoration informs or translates into management policy, to learn their thoughts and opinions about the worth of blue carbon.

About a third of them responded to the survey. The survey was closed in December 2017.

The respondents said that now is the time to reach out across the region, beginning in Puget Sound, to improve decision makers' understanding of blue carbon and spur leadership among conservation stakeholders, who have the local knowledge, organizational strength and skill to lead policy discussions, but have not yet taken the time to talk about blue carbon and fully explore its potential to leverage carbon market investments to support habitat conservation.

Among other outcomes, the working group agreed to develop a database of project results and associated online tool or viewer for decision makers. The audience said meeting presentations, webpages, workshops, and small group meetings or discussions were the best ways to learn about and access project data. Information must be presented using language that is accessible to leaders and policy makers, who may or may not be scientists.

They said, overwhelmingly (19 of 25 respondents, Q. 17), that they needed to know more about the region's blue carbon capacity, and even more overwhelmingly (23 of 25 respondents, Q. 12) they agreed

that new information about carbon sequestration would likely influence regional land use policies or regulations.

Three fifths of the respondents said it was important to develop regional carbon management policies, though not yet of highest priority. Another third policy development should be the highest priority. A quarter of respondents said blue carbon and tideland restoration were mutually reinforcing factors that could help shape carbon policies, but doubted that blue carbon alone would do so. Some thought policies should address sequestration on tidelands, in forests, through agriculture, and other land uses. None discounted the worth of blue carbon as a tool to gain some degree of leverage against greenhouse gas accumulation.

They spoke of the need for leadership, and to shift a degree of attention and funding away from fish recovery to other important needs. In the words of one respondent from Puget Sound,

“Everyone is focused on salmon recovery...and funding past that...is not necessarily readily available, nor has the community taken the time to truly discuss, understand or identify blue carbon as a potential approach...for conservation of coastal wetlands.”

There’s not much appeal in blue carbon, a “slow-scale, big picture concept” that pales when compared to natural resources or wildlife conservation. The name itself may be a barrier to understanding; it demands a detailed explanation. People, including wildlife biologists, would benefit from training in basic carbon science—and the role of blue carbon—to help them understand how to keep carbon out of the atmosphere.

Policy makers need clear and direction information on how blue carbon will benefit their community, region, or mission, both short- and long-term, including

- Sequestration rates and volumes; local estimations of current carbon sequestration to assess its importance in various regions.
- Comparative studies, before and after restoration, to demonstrate change in carbon storage.
- Interpretation projects to help people understand the value of blue carbon.
- Decision makers need location-specific economic studies and evaluations.
- Standard economic valuations to make cost-benefit comparisons.
- Methods for equating tons of carbon sequestered with acres and stream miles, to help to put climate more on par with species’ needs.
- A “quick and easy calculator” to assess blue carbon at the project level that doesn’t entail significant field work or planning delays.

The results of this study led to general recommendations to advance carbon management policies, and specific recommendations for the Pacific Northwest Coastal Blue Carbon Working Group:

General recommendations

- Provide decision-maker training and public education about blue carbon and its role in conservation and climate policy.
- Develop blue carbon demonstration projects.
- Determine the impacts of blue carbon, or its loss, on water quality (e.g., eutrophication or acidification in bays or nearshore waters).
- Seek and encourage leadership for carbon policy development and champion blue carbon as a tool for conserving tidal habitat.
- Broaden the scope of tidal wetland restoration to include blue carbon as a benefit of conservation.
- Develop carbon policies that embrace the total of sequestration resources including forest, agricultural, tidal wetland, and other land uses.
- Engage sequestration stakeholders to
 - conduct broad, comprehensive discussions of carbon policy proposals that will encompass all carbon dioxide sources and sinks;
 - improve decision makers' understanding of carbon credits, offsets, markets, and valuations;
 - demonstrate the relative contributions to carbon sinks of various land uses and activities, and
 - identify best management practices that maximize blue carbon storage.

Recommendations for the PNW Coastal Blue Carbon Working Group.

- Re-evaluate the purpose and need of the blue carbon database, and confirm its intended audience. Policy leaders and decision makers are more likely to learn about blue carbon from meeting presentations, workshops, and small group activities or discussions. The database will remain an important resource for scientists, and the Working Group will want to ensure its continued usefulness beyond the end of this project.
- Support blue carbon policies that result in a net increase in tidal wetlands restored and not to mitigate the loss of tidal wetlands elsewhere, acknowledge multiple values, and augment not supplant other environmental priorities and policies.
- Encourage carbon management policies for the PNW that protect holistic values—aesthetics, or conserving wetlands for their own sake, or to protect culturally sensitive lands, waters, and traditions of native sovereign nations—as well as those of economy and ecology.
- Work with knowledgeable partners to ensure a fair and flexible strategy to engage with native sovereign nations in Puget Sound and along the outer Washington, Oregon and California coast. In Puget Sound, the Northwest Straits Commission (NSC) works with local, federal, state and tribal governments on a range of marine resource management issues, including habitat restoration. The Northwest Indian Fisheries Commission provides natural resource management support for 20 treaty tribes in western Washington. Consider exploring opportunities to engage with either or both to collaborate with the Working Group on behalf of the represented tribes.
- Reach out to the Puget Sound Partnership, a leader of Puget Sound's restoration community, as a potential leader in blue carbon policy development.

- Share information from sequestration trials and studies conducted elsewhere with leaders and decision makers.
- Explore how carbon markets might work in the PNW.

The survey was conducted by the South Slough National Estuarine Research Reserve's Coastal Training Program, with the assistance of the Padilla Bay NERR and members of the Working Group.

The Worth of Blue Carbon: A Knowledge and Values Assessment of Conservation Policy Stakeholders in the Pacific Northwest

Introduction

Tidal wetlands are recognized for their important role in sequestering carbon dioxide (Nellemann et al. 2010). Carbon dioxide is a greenhouse gas and major contributor to global warming (Nelleman et al., 2010). The value of carbon storage on tidal wetlands—termed blue carbon—is of great interest to those developing regional, national, and global climate change adaptation and mitigation strategies, including carbon markets (Murray et al., 2011). Enough data has been collected in some regions of the world to estimate the carbon sequestration potential of tidal wetlands (Murray et al., 2011). Not enough information has been gathered, though, to estimate the capacity for blue carbon storage in saltmarshes, tidal swamps, and seagrasses in the Pacific Northwest (PNW) region, or measure the contributions of these tidal wetlands to regional carbon sequestration relative to forestry, agriculture, and other land uses. Nor is there enough information to understand whether or how state or regional climate or conservation policies could be adopted or adapted to sustain blue carbon.

The Pacific Northwest Coastal Blue Carbon Working Group (Working Group), composed of scientists, managers, land stewards, educators, and communicators representing state and federal agencies, native sovereign nations, research institutions, and conservation organizations, considers the development of blue carbon policies to be important, needed, and likely to benefit society by reducing the accumulation of greenhouse gas in the atmosphere, and providing an additional incentive for conserving and restoring tidal wetland habitat. In July 2017, the Working Group began a three-year project to quantify blue carbon in the PNW.

As an initial step, the Working Group conducted a survey of natural resource management and habitat restoration professionals whose work includes or informs the development of conservation or climate adaptation policies. These professionals represented public science, natural resource, and land management agencies, native sovereign nations, local, state, regional, and federal governments, non-profit organizations, research institutes, and universities. They were asked to respond to questions about their awareness of carbon sequestration science, ecology, and economics to identify gaps in information or knowledge, inform training or outreach needs, and clarify values that ought to be considered if, and when, state or regional carbon management policies are developed.

Methods

In laying the groundwork for this project, the Pacific Northwest Coastal Blue Carbon Working Group identified 129 individuals whose professional responsibilities included developing or contributing to the development of carbon management policies in Oregon, Washington, and California. The Working Group invited them to participate in a web-based assessment of their knowledge of blue carbon, carbon sequestration, carbon regulatory mechanisms, wetland valuations, ecosystem services, and related topics, and asked about their needs for additional information or training to inform blue carbon policy

development. The survey contained 23 multiple-choice and open-ended questions (See Appendix A). It opened in July 2017. The Working Group re-contacted the audience at monthly intervals to remind them to complete the survey. The survey closed Dec. 28, 2017.

The survey was developed using Survey Monkey (www.surveymonkey.com) and administered using methods of the National Estuarine Research Reserve System's Coastal Training Program. Coastal Training Program coordinators at the Padilla Bay, Washington, and South Slough, Oregon, National Estuarine Research Reserves (NERR) piloted the survey with working group members and made changes the members recommended. The South Slough NERR administered the survey.

Results and discussion

Some excerpts from the open-ended responses have been edited for clarity. Edited text is [bracketed]. Percentages are rounded to the nearest whole percent. Appendix A contains the full text of the open-ended responses.

The survey was distributed to 129 individuals whose professional responsibilities were related to carbon management policies. Forty-one (41) of the 129 survey recipients responded, a 32% response rate.

The response rate (32%) for this study was within the range of response rates from other web based surveys (25-30%, Kittleson 1997; 20%, Kilowatts et al. 2004; 35-40%, Cook et al. 2000). However, considering the length of the survey (23 questions), a 32% response rate is impressive. It is possible that the six-month period that the survey was accessible and monthly reminders increased response rates (Cook et al. 2000, Fox et al. 1988).

Question 1 asked: *Where do you live?*

Most respondents lived in Washington State (Figure 1).

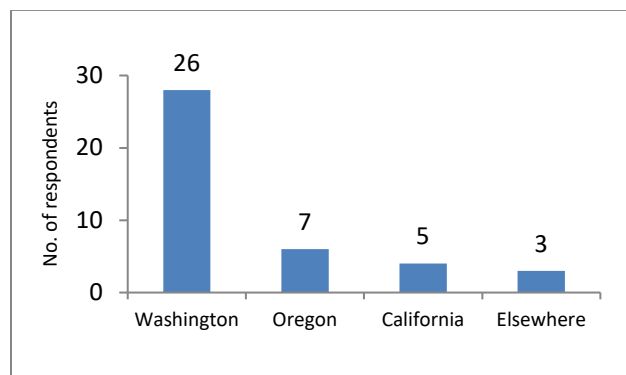


Fig. 1. Q1 - Where do you live? (n = 41)

Questions 2; Question 3.¹

¹ Question 2 requested permission for future contact. Question 3 provided a form for contact information. Responses are confidential. Contact the author for questions about individual responses.

Question 4 asked: *What stakeholder group do you represent?*

Nearly 80% of respondents represented native sovereign nations or federal or state governments (Figure 2).

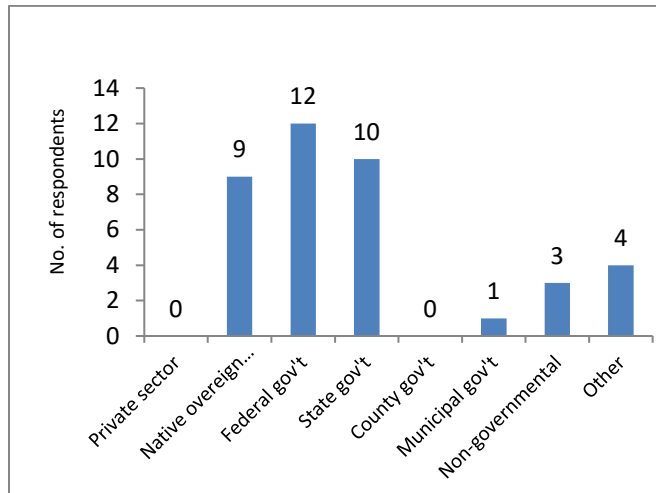


Fig. 2. Q4 - What stakeholder group do you represent? Select all that apply. (n = 36)

Question 5 asked: *What type of work do you do in the coastal zone? Select all that apply.*

The work of most respondents involved natural resource management (61%) and habitat restoration (67%), but the respondents could select more than one response. Nearly half (47%) also reported having policy advisory or development roles (Figure 3).

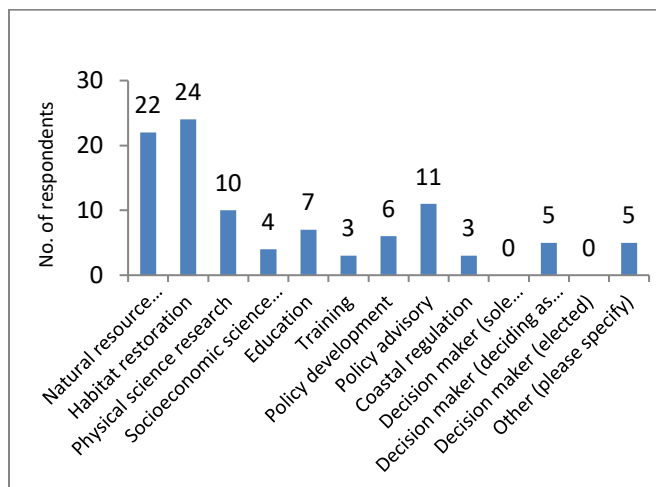
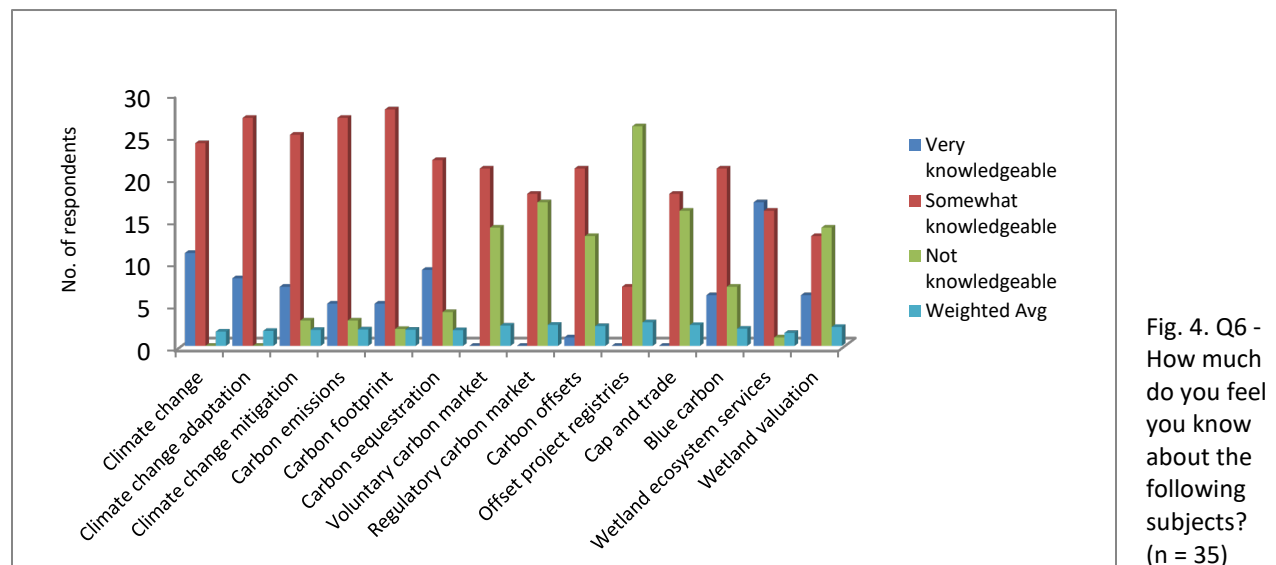


Fig. 3. Q5 - What type of work do you do in the coastal zone? Select all that apply. (n = 36)

Question 6 asked: *How much do you feel you know about the following subjects?* and presented a list of topics related to climate, carbon, and carbon markets. We asked the respondents to rate their state of

knowledge (as very knowledgeable, somewhat knowledgeable, or not knowledgeable at all) about these topics. Figure 4 presents their responses and the weighted average of the responses.



Question 6 allowed the translation of self-identified knowledgeability ratings into areas of need for outreach and training. The topics generally can be described as either physically oriented (climate change, climate change adaptation, climate change mitigation, carbon emissions, carbon footprint, carbon sequestration, wetland ecosystem services) or market-oriented (voluntary carbon market, regulatory carbon market, carbon offsets, offset project registries, cap and trade, blue carbon, wetland valuations). The weighted averages of the market topics are among the highest, indicating higher need for training. About three quarters (74%) of respondents said they were not knowledgeable at all about offset project registries.

In Table 1, all the topics are ranked according to the weighted average of responses. Generalizing from Table 1, the survey audience appears to be very knowledgeable of physically oriented topics. As the topics turn more toward the market oriented topics, the percent of respondents identifying as “not knowledgeable” rises. The median of Table 1 is 2.14, which falls close to the division between the physical and the market-oriented topics. Outreach and training focused on topics above the median would help to improve knowledgeability.

Table 1. Knowledgeability: Weighted average of responses (Q.6)

Score	Topic	Score	Topic
2.79	Offset project registries	1.94	Carbon emissions
2.49	Regulatory carbon markets	1.91	Carbon footprint
2.47	Cap and trade	1.89	Climate change mitigation
2.40	Voluntary carbon markets	1.86	Carbon sequestration
2.34	Carbon offsets	1.77	Climate change adaptation
2.24	Wetland valuations	1.69	Climate change
2.03	Blue carbon	1.53	Wetland ecosystem services

Question 7 asked: *Do you think it is important to develop carbon management policies for the Pacific Northwest?*

Three fifths of respondents said developing blue carbon management policies for the PNW was important, but not yet the highest priority (Figure 5.) Nearly a third (32%) said developing carbon policies for the PNW was “very important; should be the highest priority.”

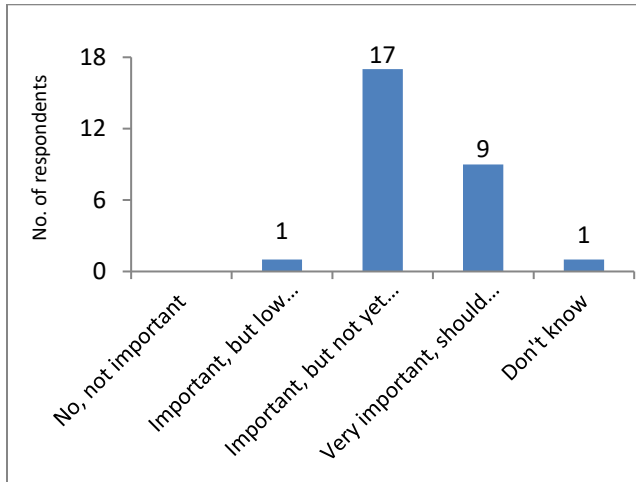


Fig. 5. Q7 - Do you think it is important to develop carbon management policies for the Pacific Northwest? (n = 28)

Question 8 asked: *Based on your current understanding, what role do you think the restoration and conservation of tidal wetlands can play in Pacific Northwest’s carbon management policies or strategies?*

The responses revealed broad interest in opportunities to increase carbon storage while restoring habitat. Some respondents thought of these as ecological services that reinforce each other and may bring about additional benefits—such as mitigating acidification or eutrophication in bays or nearshore waters—that may help the region adapt to climate change. Others wondered whether the region’s capacity for blue carbon was practically significant, while acknowledging the value of gaining whatever leverage might be possible against greenhouse gas accumulation.

A quarter of respondents said carbon sequestration and tideland restoration and conservation are mutually reinforcing factors that, together, might contribute to the development of regional carbon management policies, but doubted that blue carbon alone would do so, as was evidenced by some of their comments:

- “Carbon management will certainly be a lens to look through when prioritizing restoration efforts but I doubt it will unilaterally guide our decisions.”
- “I think it is extremely unlikely that tidal wetland conservation [or] restoration will move the regional or global carbon needle. The net carbon and methane fluxes are too small over decadal time scales to make any difference.”
- “In terms of carbon sequestration, the total area of coastal wetlands is likely much less than the total area of Pacific Northwest forests, freshwater wetlands, and agricultural lands, so although

the amount of carbon sequestered by coastal wetlands can be several times greater than that sequestered by other land cover types, I don't see coastal wetlands as the highest priority in terms of carbon management.”

- “[O]ur salt marsh is less extensive, but what does or could exist can play a role at sequestering carbon.”

None discounted the value of managing for sequestration to gain whatever leverage against greenhouse gas accumulation might be possible.

- “[R]estoring the processes that lead to carbon sequestration is one major benefit of tidal restoration (and conservation, too).”
- “Protecting o[u]r estuaries can prevent loss of carbon into the atmosphere and protection combined with restoration can sequester more carbon, offsetting a bit of the growth in the [PNW]. This should be a large portion of any carbon reduction strategy.”

Others noted there are opportunities to expand coastal wetland restoration using carbon markets.:

- “There's a lot of salmon recovery projects going on in [Oregon] and [Washington] in estuaries and tidal wetland systems, but not a lot of discussion about the potential to sequester carbon, or the benefits associated, or how to develop markets to garner more and different funding to conduct these restoration projects. Seems like we might be missing the boat a bit, as the science and policies catch up with the ongoing implementation. ... [I]t seems like an opportunity to get state or local governments or a consistent local non-profit involved in setting up demonstration projects and showing carbon sequestration benefits, development and operation of mitigation banks or carbon markets, etc. It seems like there's an opportunity here that the current restoration community is not taking advantage of, and needs some help to do so.”

Respondents noted that sea level rise presents a degree of uncertainty in planning for both carbon sequestration and tideland conservation. On one hand, managing for blue carbon may help to mitigate sea level rise, or it might spur new interest in, and support for, tidal wetland restoration. On the other, that might not be the most important role for coastal wetlands, a respondent said. “Habitat [and] water quality protection might be bigger.”

Question 9 asked: *What carbon management policies or strategies do you know about that should include a blue carbon element?*

This question challenged the respondents. Eleven of 15 said either they didn't know, were unsure, weren't familiar, or were unaware of policies, or else did not understand the question. Three respondents referred to specific strategies that might be applicable:

- Shoreline master plans
- More strategies like the Lummi Nation's wetland mitigation strategy
- A “cap-and-trade program, like California's,” for the PNW.

Washington’s Shoreline Management Act (RCW 90.58) established broad policy for Washington shorelines to “prevent the inherent harm” in uncoordinated, piecemeal development. It gave broad policy preference to uses that protect water quality and the natural environment, water dependent uses, and preserve or enhance public access.

The Lummi Nation Wetland and Habitat Mitigation Bank is the first tribally-owned and operated commercial wetland mitigation bank in the U.S., according to the tribe’s website. The bank generates credits to compensate for unavoidable adverse impacts to aquatic environments that result from projects permitted in the service area of the bank, including portions of the Nooksack River (Lummi Nation, 2017).

California’s cap-and-trade system sets a statewide limit on greenhouse gas emissions – the cap. Businesses are required to buy permits that allow them to emit of a certain amount of pollution within the cap. Businesses can also sell or trade permits, which creates a market price based on greenhouse gas emissions.

One respondent suggested, “an application that could give an estimate of [the amount of] carbon sequestered by the numerous restoration and protection projects would allow reporting of carbon sequestration along with stream [or] shoreline miles and acres protected [or] restored. This could inform decision makers on another benefit of protecting our estuaries.”

Question 10 asked: *Where do you think carbon management policies for the Pacific Northwest will provide the most benefit? Select all that apply.*

Respondents thought most of the benefits of carbon management policies would accrue locally (64%), statewide (56%), or regionally (56%). (Figure 6.)

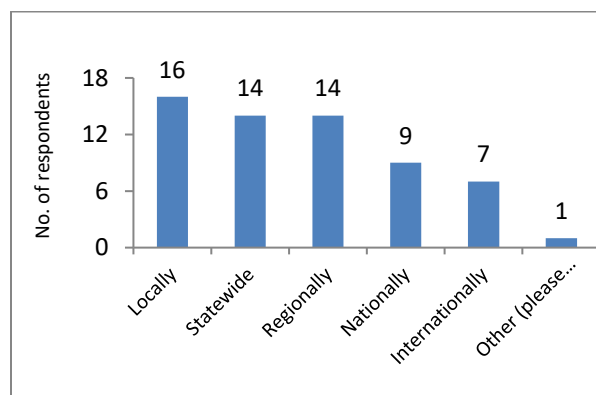


Fig. 6. Q10 - Where do you think carbon management policies for the Pacific Northwest will provide the most benefit? Select all that apply. (n = 25)

Question 11 asked: *How well do you understand how land use decisions are made in your region?*

Most (92%) respondents said they were somewhat or very knowledgeable of how land use decisions are made in their region (Figure 7).

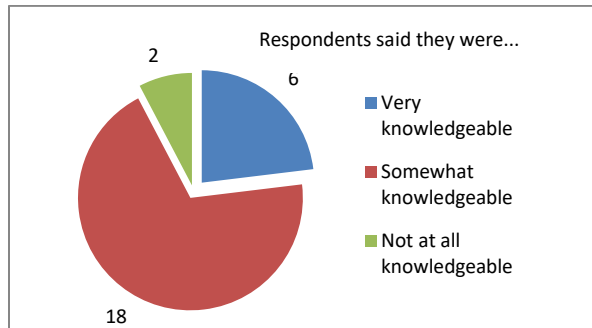


Fig. 7. Q11 - Understanding of land use decision making (n=26)

Question 12 asked: *Do you think new information about blue carbon could influence land use policies or regulations in your region?*

Twenty three of 25 respondents (Figure 8) agreed that new information (e.g., scientific data generated through this or similar projects) could influence land use policies or regulation, but they were unsure of the mechanism that would bring that about. "It is dependent on how realistically [policies] can be implemented," a respondent said. "My impression now is that information about [blue carbon] is just viewed as theoretical with no clear perspective on costs and benefits." Another suggested tracking both carbon storage and year-to-year losses of storage capacity, would allow carbon fluxes to be tracked "just like endangered species numbers."

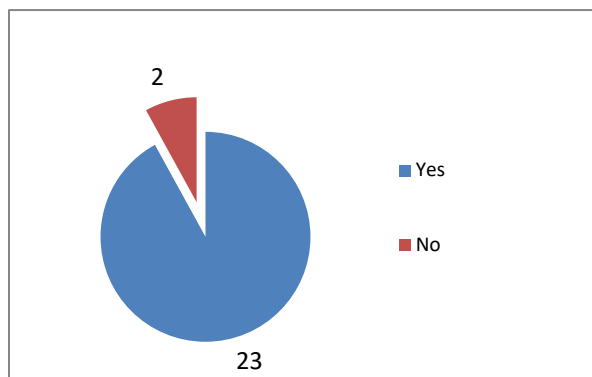


Fig. 8. Q12 - Do you think blue carbon data could influence land use policies or regulations in your region? (n=25)

Users' comments indicate they are already identifying training audiences:

- "I am...educating realtors about the benefits of tidal wetlands."
- Living shorelines projects designed for coastal dwellings could "inform the public and show immediate behavioral responses."
- Spreading blue carbon information through k-12 education "is most effective but difficult."
- "Public outreach is easier but less effective."

- Training for decision makers, about blue carbon as an added benefit of estuary protection and restoration, “would be helpful.”
- Blue carbon data can be “essential for training counties in land use planning decisions.”

Question 13 asked: *What ecosystem services are highest priority for your organization?*

All respondents identified fish habitat, and all but three identified wildlife habitat as high priorities. Carbon storage and aesthetics were ranked at lowest priority. (Figure 9.)

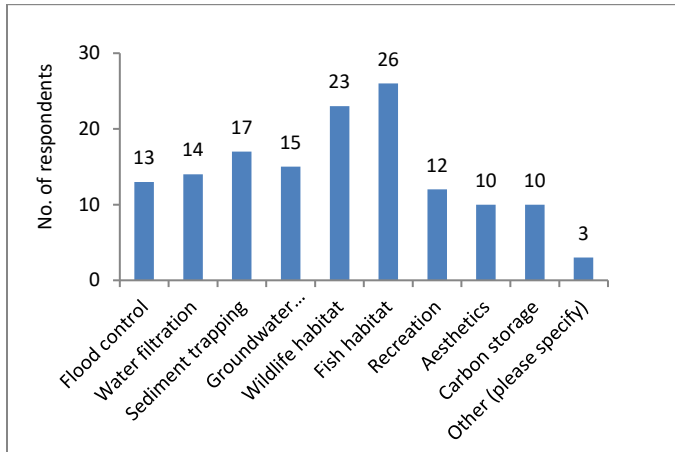


Fig. 9. Q13 - What wetland ecosystem services are priorities for your organization?

Question 14 asked: *How does your organization evaluate ecosystem services in its decision making?*

The whole of their comments suggested that for most of the respondents, the conservation of fish, wildlife, and habitat was at the core of their organizations’ goals or missions. For some, achieving the goal or carrying out the mission also requires balancing ecological benefits and economic costs; for others, not so much. Some of the respondents’ comments pointed directly or indirectly to policies either formal or implied:

- “It is part of our decisions daily.”
- “At State Parks, it is a high priority, and is considered at every level of the planning process.”
- [It is an] “important consideration of our project delivery, and as messaging tool to our partners and supporters.”

Others referred to formal organizational missions, e.g.:

- “The mission of the Samish Department of Natural Resources is to preserve, protect and enhance culturally significant natural resources and habitats within Samish Traditional Territory for current and future generations.”
- “[S]ome FWS programs inherently incorporate ecosystems services...From a recent report on this topic from [the Department of Interior]: ‘Officially, there has been no adoption of any formal [ecosystem services (ES)] framework for budget, planning, regulatory, management, and/or other types of decision-making by the Service. Informally, the Service has supported

research on ES and has several programs that consider ES without expressly incorporating an ES framework.”

Several respondents described holistic principles that guide decision making:

- “We focus on benefits to salmon and steelhead.”
- “[M]ore interested in conserving nature for its own sake than for value to humans – appealing to heart not wallet.”
- We try to use an understanding of natural function and process, and how any projects that we are considering may help to conserve the ability of these natural processes to continue into the future.”
- “Attempt a precautionary view when possible.”

That some respondents focus on measurable terms, such as presence or absence of species, or miles or acres of habitat restored, and others appeal “to heart, not wallet,” reflects a values gap between those advocating economic outcomes and those seeking holistic outcomes. This is an area policy makers and advocates might want to thoroughly explore ahead of policy development.

Question 15 asked: *What are the data gaps that prevent blue carbon from becoming a viable factor in any resource management policies or strategies you know about?*” (Question 15.)

The data gaps they identified are listed in Box I.

Not all of those responding called out data gaps, but instead took the opportunity to identify challenges or barriers that so far have contributed to a lack of leadership for blue carbon as a tool for tidal wetland conservation.

“There is a leadership void for this issue in Puget Sound,” one respondent said. “Everyone is focused on salmon recovery...and

Box I. Blue Carbon Data Gaps Identified by the Survey Audience (Q. 15)

- Sequestration rates and volumes; local estimations of current carbon sequestration to assess its importance in various regions.
- Methods for equating tons of carbon sequestered with acres and stream miles, to help to put climate more on par with species’ needs.
- A “quick and easy calculator” to assess blue carbon potential for a given habitat restoration project that doesn’t entail significant field work or planning delays.
- Demonstration projects to help people understand the value of blue carbon. Decision makers particularly may need location-specific economic studies and evaluations.
- Comparative studies, before and after restoration, to demonstrate change in carbon storage.
- Standard economic valuations to make cost-benefit comparisons.
- In some cases, lack of authority to regulate shoreline development or enforce shoreline management codes.

funding past that approach is not necessarily readily available, nor has the community taken the time to truly discuss, understand or identify blue carbon as a potential approach that could be used to attract more interested parties for conservation of coastal wetlands...they are just not focused on blue carbon as an option.” The challenge extends to physical scientists. “In our agency we are mostly biologists, and focused on fish and wildlife species and their habitats,” a respondent said. “We lack physical science expertise, and lack leadership on this issue.” There is little support for policies that would either increase blue carbon in estuaries or reduce methane emissions from fresh or brackish wetlands, a respondent said.

Nor is there much public appeal in blue carbon. It’s a “slow-scale, big picture concept” that pales when compared to natural resource management or wildlife conservation. The name itself may be a barrier to understanding; it demands a detailed explanation. People, including wildlife biologists, would benefit from training in basic carbon science—and the role of blue carbon—to help them understand how to keep carbon out of the atmosphere. To the extent that it’s seen primarily as an economic mitigation measure, blue carbon lacks relevance to habitat restoration and wildlife conservation. Policy makers don’t yet recognize the carbon market as a tool for mitigating climate change.

Question 16 asked: *“How would quantitative blue carbon information facilitate the development or implementation of resource management policies or strategies you know about?”*

Policy makers need “clear and direct information” on how blue carbon will benefit their community, region, or mission, short- and long-term. By providing a “tangible context” for policy discussions, quantitative sequestration data will provide guidance for policy makers on how blue carbon will benefit coastal communities—and the PNW region—over both the short and long term. Collecting such data is the first step to realizing carbon-based policies and markets. The data will become the “backbone” of future policies – if policies “realistically” can be implemented: “My impression now is that information about [blue carbon] is just viewed as theoretical with no clear perspective on costs and benefits,” a respondent said.

Quantitative data might elevate the priority of estuarine conservation and, through demonstration projects that integrate blue carbon with restoration goals, support a range of innovative conservation measures if, and only if, blue carbon “can be shown to be quantitatively important on regional-to-global and decadal space and time scales.” A respondent reiterated, “I think the best bet is finding an organization who will follow it through, be a champion, and do some demonstration projects throughout the PNW, so all could see that there are other options out there past our current intense focus on recovery of listed salmonids.”

Question 17 asked: *Are you or your organization in need of quantitative blue carbon information?* Nineteen of 25 said yes.

Question 18 asked: *“What kind of quantitative blue carbon information do you need?”* The overwhelming answers from 18 respondents:

- Sequestration rates and volumes of carbon sequestered

- Demonstrations or comparative studies to inform stakeholders
- Training and education to help integrate blue carbon and conservation policies.

Again, reemphasizing the need for leadership, a respondent urged the Working Group to reach out to the Puget Sound Partnership, or other climate-focused non-profit, the U.S. Environmental Protection Agency, or Washington Department of Ecology, to take the lead on training, demonstration projects, and policy initiatives.

Question 19 asked: *What is the best way to learn about and access blue carbon data?*

At the project's outset, the Working Group envisioned hosting training workshops at project's conclusion (in 2020) to share results with the survey audience and others. Training would be informed by the results of this assessment and directly address the use of carbon sequestration data generated by this project. Training would include use of a project database. Figure 11 presents the respondents' preferences for gaining information. Of the options we presented, three quarters of respondents preferred getting information through meeting presentations or from a webpage. Seventy percent (70%) preferred workshops, and 60% preferred small group meetings or discussions.

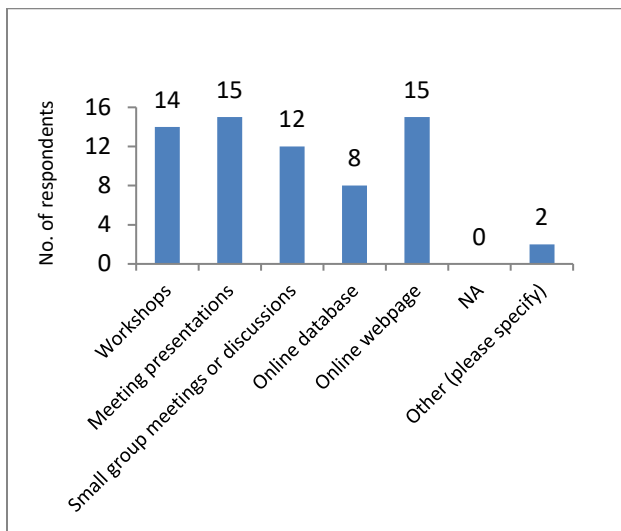


Fig. 11. Q19 - What is the best way to learn about and access blue carbon data? (n = 20)

The responses to Question 19 also suggest that a key proposed outcome of the project—a database of blue carbon quantifications, searchable with an associated tool or viewer—might not be the most useful tool or product for policy advisors or decision makers. It was favored by 40% of the respondents.

The results suggest that outreach might be more effecting now rather than later, and with a slightly different objective: to engage conservation stakeholders, native sovereign nations, and others to lead the development of comprehensive carbon management policies that reduce greenhouse gas emissions, sequester carbon, conserve habitat, protect water quality, support market opportunities, and integrate blue carbon with other sequestration resources.

Question 20 asked: *In the region in which you work, what other individuals or organizations do you think need blue carbon information?*

The audiences the respondents identified are presented in Box II.

Questions 21 and 22 provided a final opportunity for respondents to provide their contact information and indicate their willingness for further contact.

Finally, Question 23 asked: *What other questions should the Working Group be asking?*

Box II. Stakeholders in need of blue carbon information (Q. 20)

- Scientists, managers, policy advisors, leaders
- Native sovereign nations of Washington, Oregon, and California
- Conservation groups
- Salmon recovery lead entities
- Regulators, cap-and-trade programs, enforcers of Washington's Shoreline Management Act
- Coastal and shoreline planners
- Citizen science organizations
- Puget Sound Partnership
- Northwest Straits Commission
- Northwest Indian Fisheries Commission
- County, city, state, federal, and tribal resource management agencies

A respondent from the Puget Sound region encouraged the Working Group "to think about how you effectively engage with a very solid, skilled salmon restoration/recovery community" in Puget Sound. "Introduce this opportunity to them and others who might need mitigation, or are interested in conservation beyond other purposes of salmon recovery."

Recommendations

The results of this study lead to some general recommendations for stakeholders who desire to advance carbon management policies, and specific recommendations for the Pacific Northwest Coastal Blue Carbon Working Group:

General recommendations

- Develop blue carbon demonstration projects based on quantitative data.
- Determine what impacts, if any, increases or decreases in the rates or volumes of sequestered carbon may have on water quality (e.g., eutrophication or acidification in bays or nearshore waters).
- Provide leadership in carbon policy development, champion blue carbon, and build the capacity of the restoration community.
- Broaden the scope of tidal wetland restoration to include blue carbon as a benefit of conservation. (Although some respondents thought the capacity for blue carbon might prove to be less in the PNW than in other areas, they said it was nonetheless an important component of regional carbon sequestration.)
- Engage stakeholders in agriculture, forestry, and other land uses with carbon sequestration potential, to

- broaden the base for comprehensive discussions of carbon policy proposals to encompass all sources and sinks of carbon dioxide'
- improve decision makers' understanding of carbon credits, offsets, markets, and valuations;
- demonstrate the relative contributions to carbon sinks of various land uses and activities (e.g., wetlands vs. agricultural lands, wetlands before and after restoration, comparisons with similar lands and uses in other regions), and
- identify best management practices that maximize blue carbon storage.
- Develop carbon policies that embrace the total of sequestration resources, including forests, agricultural lands, and tidal wetlands.

Recommendations for the PNW Coastal Blue Carbon Working Group.

- Re-evaluate the purpose and need of the blue carbon database, and especially its usefulness to policy makers, leaders, and decision makers. For example, decision makers might find greater utility in various products, such as white papers, analyses, syntheses or other products derived from the data, that they can share in meetings, workshops, or policy briefs, rather than the database itself. (The database will remain an important resource for scientists.)
- Ensure that carbon management policies developed for the PNW protect holistic values—such as aesthetics, or conserving wetlands for their own sake, or to protect culturally sensitive lands, waters, and traditions of native sovereign nations—in conservation and climate policies, in addition to furthering economic and ecological outcomes.
- Continue to reach out to native sovereign nations in Puget Sound and along the outer Washington, Oregon and California coast. Two regionally-based organizations may be poised to assist in engaging the tribes. The Northwest Straits Commission works with local, federal, state and tribal governments on a range of marine resource management issues, including habitat restoration. The Northwest Indian Fisheries Commission provides natural resource management support for 20 treaty tribes in western Washington. Either or both may be amenable to engaging with the Working Group on behalf of the tribes.
- Reach out to the Puget Sound Partnership, a leader of Puget Sound's restoration community, as a potential leader in blue carbon policy development.
- Explore how carbon markets might work in the PNW.
- Develop carbon policies that result in a net increase in tidal wetlands restored and are not used to mitigate the loss of tidal wetlands elsewhere, acknowledge multiple values, and augment, not supplant, other environmental priorities and policies.
- Share information from sequestration trials and studies conducted elsewhere with leaders and decision makers.

Conclusion

The results of this assessment indicate that now is the time to begin regional outreach and engagement to improve understanding of blue carbon and spur leadership, beginning in Puget Sound. The findings

presented in Table 1 offer a good point of departure for planning training. Training in Washington might be designed with Washington's Shoreline Management Act (SMA) in mind. The Act requires developers to include shoreline restoration in their plans and engages numerous state and federal regulatory and resource management agencies (Diefenderfer et al., 2009).

Currently most interest in blue carbon lies within Puget Sound, but stakeholders there have not yet taken the time to discuss blue carbon and fully explore its potential to leverage blue carbon-based investments as a goal of habitat conservation. The restoration community is almost exclusively focused on salmon recovery. Unless a restoration project has salmon recovery among its goals, money is not generally forthcoming. Determining training needs in Oregon and northern California was problematic, since the response from those states was low (seven responses from Oregon; five from California). (Figure 1.) Training could be extended to the rest of the PNW coastal region as interest in blue carbon grows.

The Working Group might want to reconsider the role of the proposed database, who will use it, and how products derived from it can best be designed to inform decision-making. The most likely users of the database itself will be scientists, to further their understanding of carbon sequestration science and inform future studies, but decision makers will need information in the form of research or information reports, white papers, policy briefs, maps and visualizations, or other products that are designed to meet their expressed needs. Product development might be guided by a lead entity, working with a broadly-based stakeholder group. Products might also include services, such as facilitation of small group activities, focused discussions, or other services that decision makers identify. It will be helpful for the Working Group to present blue carbon science using language that is accessible to leaders and policy makers, who may not be scientists. Blue carbon values need to be prepared and presented in a way that allows quick comparisons with other ecosystem values.

Unintended consequences may arise as the pros and cons of restorative actions are weighed – for example, planning a levee setback or removal. “Is the restoration a bigger benefit,” a respondent asked, “or the long-term storage of carbon? Presumably all the carbon that is stored in the sediments is released from the mobilization of sediments.”

“If we prioritize blue carbon services,” asked another, “does that mean we should pave over brackish and freshwater marshes that are net contributors to global warming? [O]bviously not – but that means we need to think about integrating multiple values and how each [one] ranks in conservation [and] restoration decisions.”

Bragg, J., 2017. The Worth of Blue Carbon: A Knowledge and Values Assessment of Conservation Policy Stakeholders in the Pacific Northwest. South Slough National Estuarine Research Reserve, PO Box 5417, Charleston, Oregon, USA 97420.

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Appendix A

End User Needs Assessment – list of questions

1. Where do you live?
2. May we contact you?
3. Contact information.
4. What stakeholder group do you represent? Select all that apply.
5. What type of work do you do in the coastal zone? Select all that apply.
6. How much do you feel you know about the following subjects?
7. Do you think it is important to develop carbon management policies for the Pacific Northwest?
8. Based on your current understanding, what role do you think the restoration and conservation of tidal wetlands can play in Pacific Northwest's carbon management policies or strategies?
9. What carbon management policies or strategies do you know about that should include a blue carbon element?
10. Where do you think carbon management policies for the Pacific Northwest will provide the most benefit? Select all that apply.
11. How well do you understand how land use decisions are made in your region?
12. Do you think new information about blue carbon could influence land use policies or regulations in your region?
13. What ecosystem services are priorities for your organization?
14. How does your organization evaluate ecosystem services in its decision making?
15. What are the data gaps that prevent blue carbon from becoming a viable factor in any resource management policies or strategies you know about?
16. How would quantitative blue carbon information facilitate the development or implementation of resource management policies or strategies you know about?
17. Are you or your organization in need of quantitative blue carbon information?
18. What kind of quantitative blue carbon information do you need?
19. What is the best way for you or your organization to learn about and access blue carbon data? Select all that apply.
20. In the region in which you work, what other individuals or organizations do you think need blue carbon information?
21. Repeats request for contact information
22. Repeats provision for contact information
23. Is there a question we have not yet asked that you think should be addressed as we begin this work?

End User Needs Assessment – all responses

Responses as of December 28, 2017

1. Where do you live?

ANSWER CHOICES	RESPONSES	TOTAL
Washington	63.41%	26
Oregon	17.07%	7
California	12.20%	5
Elsewhere (please specify)	7.32%	3
Total Respondents: 41		

2. May we contact you?

ANSWER CHOICES	RESPONSES	TOTAL
▼ Yes	65.85%	27
▼ No	34.15%	14
▼ Comment	Responses 0.00%	0
TOTAL		41

3. Contact information

Replies are confidential. Please contact John Bragg, (john.bragg@state.or.us) with questions about contact information.

4. What stakeholder group do you represent? Select all that apply.

ANSWER CHOICES	RESPONSES	TOTAL
▼ Private sector	0.00%	0
▼ Sovereign tribal nation	25.00%	9
▼ Federal government	33.33%	12
▼ State government	27.78%	10
▼ County government	0.00%	0
▼ Municipal government	2.78%	1
▼ Non-governmental organization	8.33%	3
▼ Other	Responses 11.11%	4
Total Respondents: 36		

5. What type of work do you do in the coastal zone? Select all that apply.

ANSWER CHOICES ▼	RESPONSES	TOTAL
▼ Natural resource management	61.11%	22
▼ Habitat restoration	66.67%	24
▼ Physical science research	27.78%	10
▼ Socioeconomic science research	11.11%	4
▼ Education	19.44%	7
▼ Training	8.33%	3
▼ Policy development	16.67%	6
▼ Policy advisory	30.56%	11
▼ Coastal regulation	8.33%	3
▼ Decision maker (sole decider)	0.00%	0
▼ Decision maker (deciding as member of a board, group or committee)	13.89%	5
▼ Decision maker (elected)	0.00%	0

How much do you feel you know about the following subjects?

	VERY KNOWLEDGEABLE	SOMEWHAT KNOWLEDGEABLE	NOT KNOWLEDGEABLE AT ALL	TOTAL	WEIGHTED AVERAGE
Climate change	31.43% 11	68.57% 24	0.00% 0	35	1.69
Climate change adaptation	22.86% 8	77.14% 27	0.00% 0	35	1.77
Climate change mitigation	20.00% 7	71.43% 25	8.57% 3	35	1.89
Carbon emissions	14.29% 5	77.14% 27	8.57% 3	35	1.94
Carbon footprint	14.29% 5	80.00% 28	5.71% 2	35	1.91
Carbon sequestration	25.71% 9	62.86% 22	11.43% 4	35	1.86
Voluntary carbon market	0.00% 0	60.00% 21	40.00% 14	35	2.40
Regulatory carbon market	0.00% 0	51.43% 18	48.57% 17	35	2.49
Carbon offsets	2.86% 1	60.00% 21	37.14% 13	35	2.34
Offset project registries	0.00% 0	21.21% 7	78.79% 26	33	2.79
Cap and Trade	0.00% 0	52.94% 18	47.06% 16	34	2.47
Blue carbon	17.65% 6	61.76% 21	20.59% 7	34	2.03
Wetland ecosystem services	50.00% 17	47.06% 16	2.94% 1	34	1.53
Wetland valuation	18.18% 6	39.39% 13	42.42% 14	33	2.24

[Comments \(1\)](#)

6. Do you think it is important to develop carbon management policies for the Pacific Northwest?

ANSWER CHOICES	RESPONSES	TOTAL
No, not important	0.00%	0
Important, but low priority	3.57%	1
Important, but not yet the highest priority	60.71%	17
Very important, should be highest priority	32.14%	9
Don't know	3.57%	1
TOTAL		28

[Comments \(4\)](#)

8. Based on your current understanding, what role do you think the restoration and conservation of tidal wetlands can play in Pacific Northwest's carbon management policies or strategies?

1. Extremely important
2. Wetlands will act as a carbon sink
3. Protection of existing and restoration of tidal wetlands can provide carbon sinks and sequester carbon thus mitigating greenhouse gas emission.
4. Quite important; primarily due to the number of acres of diked, former tidelands, that can potentially be restored.
5. Based on my current understanding since we lack a continental shelf our salt marsh is less extensive, but what does or could exist can play a role at sequestering carbon. I understand that there are opportunities for landowners as well with soft shore armoring and living shoreline designs
6. dual role of preserving key habitats that support important species and sequestering carbon.
7. One part of a combination of several policies and strategies
8. High
9. They could provide banking opportunities, which would result in more restoration being accomplished.
10. Opportunities with shared outcomes exist
11. can help sequester carbon
12. Restoring the processes that lead to carbon sequestration is one major benefit of tidal restoration (and conservation, too).
13. There are opportunities to expand Coastal Wetland Restoration through promoting it as a market or mitigation sites for habitat impacts in Puget Sound and the Washington Coast. If we could add Carbon markets on top of ongoing restoration efforts, we might be able to pull in more funding from an untapped source.
14. Specifically for carbon management in the PNW, my understanding is that the native eelgrass has low capacity to store carbon compared to other species internationally but it has a greater capacity than other macrophytes. Therefore, I am hesitant about its ability as an effective management strategy. However, I think any bit helps and there are a plethora of other benefits that macrophytes and wetlands provide that can help the region adapt to climate change and ocean acidification. Pushing the protection and restoration of tidal wetlands should be a priority.
15. Quite an important role, based on my limited understanding.
16. Protecting or estuaries can prevent loss of carbon into the atmosphere and protection combined with restoration can sequester more carbon, offsetting a bit of the growth in the Pacific NW. This should be a large portion of any carbon reduction strategy.
17. There's a lot of salmon recovery projects going on in OR and WA in estuaries and tidal wetland systems, but not a lot of discussion about the potential to sequester carbon, or the benefits associated, or how to develop markets to garner more and different funding to conduct these restoration projects. Seems like we might be missing the boat a bit, as the science and policies catch up with the ongoing implementation. Since the Feds are not likely

- to tout this much, it seems like an opportunity to get state or local governments or a consistent local non-profit involved in setting up demonstration projects and showing carbon sequestration benefits, development and operation of mitigation banks or carbon markets etc. It seems like there's an opportunity here that the current restoration community is not taking advantage of, and needs some help to do so.
18. Preservation and restoration of tidal wetlands should be a primary factor among a host of options for carbon sequestration. Maintaining tidally influenced wetlands capture and store carbon at very low costs.
 19. Local policy and habitat management should focus on protecting coastal wetlands from sea-level rise and impending coastal squeeze before they consider including blue carbon as a critical element in their carbon management strategies.
 20. You should probably 'count' any carbon benefits from the projects that are done for other benefits, but it seems unlikely that 'blue carbon' considerations will ever be the deciding factor for a restoration project.
 21. Don't have enough information to answer this question.
 22. Wetland mitigation required under section 404 of the clean water act
 23. keep it in the ground, no methane hydrate extraction,
 24. Washington's voter led initiative on carbon (expected in 2018) and the WA state legislature is developing carbon legislation for 2018.
 25. coastal wetland restoration
 26. Coastal wetlands and eelgrass beds appear to be highly viable carbon sinks and are also crucial habitat for economically and ecologically valuable wildlife species. In terms of carbon sequestration, the total area of coastal wetlands is likely much less than the total area of Pacific Northwest forests, freshwater wetlands, and agricultural lands, so although the amount of carbon sequestered by coastal wetlands can be several times greater than that sequestered by other land cover types, I don't see coastal wetlands as the highest priority in terms of carbon management.
 27. I think it is extremely unlikely that tidal wetland conservation/restoration will move the regional or global carbon needle. The net carbon and methane fluxes are too small over decadal time scales to make any difference.
 28. I think that conservation of tidal wetlands would be another tool in the toolbox, and also let people know about the possibility of carbon sequestration with this type of land. It might lead to more interest and support for coastal wetland restoration and conservation, which would be good with the changing climate and SLR
 29. They are a vital resource to sequester carbon and should be protected and enhanced.
 30. restoration and conservation can play a significant role - especially if innovative strategies such as riparian management can come into play
 31. Am unsure-- don't know if restored tidal wetlands have a net gain in carbon storage or if tidal wetlands are submerged by rising seas, if conservation of tidal wetlands would be a net gain in carbon storage. That might not be their most important role... habitat, water quality protection might be bigger

32. I think this needs further investigation. Carbon management will certainly be a lens to look through when prioritizing restoration efforts but I doubt it will unilaterally guide our decisions.
33. A significant role. There has been a large loss, but some restoration is possible.

9. What carbon management policies or strategies do you know about that should include a blue carbon element?

1. I don't know of any carbon management policies or strategies in effect.
2. Unsure, this is the first I have heard the term blue carbon.
3. Shoreline Master Plans, wetland mitigation policy
4. I'm not aware of carbon management policies
5. don't know
6. I don't know enough about what carbon management policies or strategies are being proposed or even considered to answer this question.
7. not sure
8. I am not very familiar with any carbon management policies or strategies.
9. cap and trade program like CA would be good in Pac NW
10. Did not understand question
11. don't know
12. More strategies like Lummi Nation's wetland mitigation should be implemented.
13. Not educated about this
14. An application that could give an estimate of carbon sequestered by the numerous restoration and protection projects would allow reporting of carbon sequestration along with stream/shoreline miles and acres protected/restored. This could inform decision makers on another benefit of protecting our estuaries.
15. None at this point

10. Where do you think carbon management policies for the Pacific Northwest will provide the most benefit? Select all that apply.

ANSWER CHOICES	RESPONSES	TOTAL
▼ Locally	64.00%	16
▼ Statewide	56.00%	14
▼ Regionally	56.00%	14
▼ Nationally	36.00%	9
▼ Internationally	28.00%	7
▼ Other (please specify)	Responses 4.00%	1
Total Respondents: 25		

11. How well do you understand how land use decisions are made in your region?

ANSWER CHOICES	RESPONSES	TOTAL
▼ Very knowledgeable	23.08%	6
▼ Somewhat knowledgeable	69.23%	18
▼ Not at all knowledgeable	7.69%	2
TOTAL		26

12. Do you think new information about blue carbon could influence land use policies or regulations in your region?

ANSWER CHOICES	RESPONSES	TOTAL
▼ Yes	92.00%	23
▼ No	8.00%	2
TOTAL		25

[Comments \(9\)](#)

13. What ecosystem services are priorities for your organization?

ANSWER CHOICES	RESPONSES	TOTAL
▼ Flood control	50.00%	13
▼ Water filtration	53.85%	14
▼ Sediment trapping	65.38%	17
▼ Groundwater recharge	57.69%	15
▼ Wildlife habitat	88.46%	23
▼ Fish habitat	100.00%	26
▼ Recreation	46.15%	12
▼ Aesthetics	38.46%	10
▼ Carbon storage	38.46%	10
▼ Other (please specify)	Responses 11.54%	3
Total Respondents: 26		

Q14. How does your organization evaluate ecosystem services in its decision making?

1. It is part of our decisions daily.
2. Unsure
3. The mission of the Samish Department of Natural Resources is to preserve, protect and enhance culturally significant natural resources and habitats within Samish Traditional Territory for current and future generations.
4. Reservation-wide plans with functional assessment scores for features (e.g., wetlands); databases with specific records on species observations (e.g., salmon in stream reaches).
5. currently little to no discussion of the valuation of ecosystem services of tribal properties or restoration projects are considered

6. Ecosystem services are difficult to quantify, so we evaluate the presence or absence of impacts in reviewing development proposals. Maintaining them is a very high priority for the tribe.
We incorporate some level of ecosystem/ecological assessment with all of our land management decisions. That does not mean that we always follow the related recommendations.
7. At State Parks, it is a high priority, and is considered at every level of the planning process
8. We focus on benefits to salmon and steelhead
9. Important consideration of our project delivery, and as messaging tool to our partners and supporters
10. more interested in conserving nature for its own sake than for value to humans -- appealing to heart not wallet
11. Only anecdotally and qualitatively most of the time, though we have made a few forays into quantitative estimation.
12. We look for projects that address full ecosystem function and processes. We are not interested in fixing problems... we are interested in ecosystem function restoration.
13. Our organization does not directly evaluate ecosystem services.
14. Ecosystem services are not a codified part of decision-making...not, for example, for obligating funds in my program (Coastal Program). But some FWS programs inherently incorporate ecosystems services, for example, the National Wildlife Refuge System, our Fisheries programs, pollinator programs, the Wildlife and Sport Fish Restoration Program, and the Landscape Conservation Cooperatives. From a recent report on this topic from DOI: "Officially, there has been no adoption of any formal [ecosystem services (ES)] framework for budget, planning, regulatory, management, and/or other types of decision-making by the Service. Informally, the Service has supported research on ES and has several programs that consider ES without expressly incorporating an ES framework."
15. [Peripheral.] We know ecosystems offer a lot of services, but we talk in acres or miles of habitat for species.
16. We strive to look beyond just benefits to Fish and Wildlife habitat, and work with our partners to get to where the projects we support address and support ecosystem or landscape level functions processes and services.
17. Attempt a precautionary view when possible.
18. We try to use an understanding of natural function and process, and how any projects that we are considering may help to conserve the ability of these natural processes to continue into the future, and provide the ecosystem services function and benefit fish and wildlife habitat and the processes they depend upon. We try not to promote those actions that may constrain the sustainability of an ecosystem process or function, resulting in detriments to natural ecosystem function.
19. Fish and wildlife habitat maintenance or improvement.
20. many ways - cost benefit, benefit transfer, HEA etc.
21. Considers them qualitatively but rarely has quantitative valuations.
22. part of the big picture

Q15. What are the data gaps that prevent blue carbon from becoming a viable factor in any resource management policies or strategies you know about?

1. There is a perception blue carbon is a mitigation position in environmental policy and therefore has no role in our work.
2. Having an assessment/ estimate of current carbon sequestration on the Reservation or in the local area to assess how important it is in our region or how the habitat could be improved.
3. Lack of understanding by policy makers | shoreline development pressures | Current Administration's focus away from climate change issues
4. Greater public awareness and information that compares blue carbon data in coastal wetlands to other land cover types.
5. Whether Port Susan is a viable option to apply the strategy, implementation, and the market.
6. Quantifying the amount of carbon sequestered in specific areas.
7. How to assess the benefits ecologically and "standard" economic valuation needed to make cost benefit comparison.
8. We don't manage the intertidal zone
9. It would be good to have more before/after studies to determine the change in carbon storage before and after habitat restoration.
10. carbon sequestration rates across habitat types and conditions
11. I think that all in the Puget Sound restoration community struggle with understanding how you might quantify blue carbon, what might be a good demonstration site etc. There is a leadership void for this issue in Puget Sound... Everyone is focused on salmon recovery (mostly) and funding past that approach is not necessarily readily available, nor has the community taken the time to truly discuss, understand or identify blue carbon as a potential approach that could be used to attract more interested parties for conservation of coastal wetlands. there is a strong restoration community here, they are just not focused on blue carbon as an option for them to pursue as of yet.
12. Lack of a real policy or market driver for carbon sequestration or reduction in [methane] emissions.
13. Differences in carbon uptake and sequestration effectiveness across various habitat types appears to be lacking.
14. Outside my area of expertise
15. Accounting for the tons of carbon sequestered along with the acres and miles reported. This could help push climate to be more on par with species needs.
16. Accounting for the tons of carbon sequestered along with the acres and miles reported. This could help push climate to be more on par with species needs.
17. Quick and easy calculator that could be used without significant field studies, or delaying a habitat restoration project.

18. an understanding of how to make it happen. A demonstration project would be helpful. in our agency we are mostly biologists, and focused on Fish and Wildlife species and their habitats, we lack physical science expertise, and lack leadership on this issue. If an individual biologist decides they have the time to explore this issue, that's great, but it's not currently identified as a priority, but as something that we all need to be aware of.
19. Carbon sequestration and the relative contribution of coastal wetlands is poorly understood by many decision makers. Blue carbon is a slow-scale, "big picture" concept that is less appealing to policymakers and the general public when compared to natural resource and wildlife conservation.
20. translation and other banking efforts
21. research into magnitude, research across a gradient of salinity and habitat types
22. Unclear "where" the hot beds of blue carbon are. Also, how weigh the pros/cons of, for example, a levee setback or removal. Presumably all the carbon that is stored in the sediments is released from the mobilization of sediments. Is the "restoration" a bigger benefit or the long-term storage of carbon?
23. specific restoration protocols

Q16. How would quantitative blue carbon information facilitate the development or implementation of resource management policies or strategies you know about?

1. It should elevate the priority of estuarine conservation and restoration.
2. Unsure
3. Provide education as to ecosystem services offered by coastal wetlands allow for mitigation strategies to be developed
4. Wetlands are already protected by laws and the policy of no-net-loss. However, those laws are not always enforced and wetlands are being lost. While quantifying the additional benefit of blue carbon is good, it does not address the root problem: lack of political will and subsequent lack of resources to enforce the law.
5. this information could be integrated in land management decisions.
6. It maybe could for wetland habitat restoration prioritization.
7. could show that we need to restore top predators or reduce eutrophication to enhance blue carbon value of wetlands
8. I think we need someone to start a demonstration project, or provide beginning leadership. Then others could start to understand how it might work, move forward with identifying opportunities, and get a program going.
9. We are working on that right now, actually.
10. For our organization, it will assist in identifying restoration sites and communicating the benefits of such projects.
11. Quantitative information would provide a tangible context in which to discuss the pros and cons of blue carbon. It would also provide a backbone to any policy.
12. outside of my area of expertise
13. Discussed throughout the preceding questions

14. Again, I think the best bet is finding an organization who will follow it through, be a champion, and do some demonstration projects throughout the PNW, so all could see that there are other options out there past our current intense focus on recovery of listed salmonids.
15. quantitative info would be the first step to making "it real"
16. could facilitate and leverage implementation of habitat development projects
17. I could be incorporated along with other factors in deciding which habitat restoration project is pursued.
18. If we had a project showing us all how to move forward, and the benefits of taking such an approach, it might result in a change in policy to focus in on these opportunities.
19. Policymakers and practitioners need CLEAR AND DIRECT information on how blue carbon sequestration will benefit their system/community/region in the short and long term.
20. As stated earlier, blue carbon will only change resource management policies and strategies if/when it is shown to be quantitatively important on regional-to-global and decadal space and time scales.
21. If there are known areas where blue carbon naturally concentrates, we can make aquatic management decisions that account for this sequestration service.
22. add rationale for actions

Q17. Are you or your organization in need of quantitative blue carbon information?

ANSWER CHOICES	RESPONSES	TOTAL
▼ Yes	76.00%	19
▼ No	24.00%	6
TOTAL		25

Q18. What kind of quantitative blue carbon information do you need?

1. The legal obligations and financial elements.
2. Quantitative information about how much carbon is sequestered by wetlands or what the impact would be if we were to improve the habitat.
3. benefit per acre of preserved or restored wetland and restoration best management practices to maximize blue carbon storage
4. Comparing carbon stored in coastal wetland types vs. typical agricultural land.
5. links to good sources
6. See question #15
7. Before/after carbon storage comparison at restoration sites.
8. Basic training, sharing of information from other areas that have experience. What about approaching the Puget Sound Partnership, or EPA or the Washington Department of Ecology, or another climate focused non-profit, and work together on putting on a workshop for starters, and start a discussion about doing a demonstration project

- somewhere in Puget Sound. I think the idea needs to be brought to the restoration community, and help them with looking for opportunities and how to move forward.
9. Local data on carbon sequestration in healthy wetlands, pre- and post- implementation data on carbon fluxes at project sites.
 10. How much carbon do nearshore and subtidal habitats sequester per acre?
 11. Carbon storage per acre for different types of tidal wetlands and macrophytes.
 12. outside my area of expertise
 13. outside my area of expertise
 14. as stated before, , if there was an application where we could easily enter basic information about a project and determine impacts to blue carbon sequestered by that project.
 15. basic information about how it works, and how to make it work in any project that it may apply to.
 16. As I Indicated previously, a demonstration project that would help all learn about the process, and results would be beneficial. I think we do not really know how to start to think about accomplishing a blue carbon project.
 17. values
 18. information that is either estuary specific or that has clear direction based on salinity regimes, habitat types etc. that could be applied to local situations.
 19. Heat maps of where the blue carbon is. It would also be interesting and informative, to carry the same carbon storage scale onto terrestrial systems adjacent to marine/aquatic lands for further comparison.

Q19. What is the best way for you or your organization to learn about and access blue carbon data?
Select all that apply.

ANSWER CHOICES	RESPONSES	TOTAL
▼ Workshops	70.00%	14
▼ Meeting presentations	75.00%	15
▼ Small group meetings or discussions	60.00%	12
▼ Online database	40.00%	8
▼ Online webpage	75.00%	15
▼ NA	0.00%	0
▼ Other (please specify) Responses	15.00%	3
Total Respondents: 20		

Q20. In the region in which you work, what other individuals or organizations do you think need blue carbon information?

1. Washington coastal Tribes
2. Other Tribes, county and city governments, state and federal agencies, non profit environmental organizations, the general public, permitting entities
3. Other tribes and counties possibly non profits
4. All regulatory jurisdictions and resource managers

5. State and County regulatory agencies
6. I'm not sure
7. cap and trade programs
8. Puget Sound Partnership, Washington Department of Ecology, Washington Department of Natural Resources, Washington Department of Fish and Wildlife, Washington department of Transportation (impact coastal wetlands with road/highway construction). Washington State Parks, local shoreline conservation groups, local salmon recovery lead entities, Washington Recreation and Conservation Office, National Marine Fisheries Service, US Army Corps of Engineers, Local city permitting agents and enforcers of the Shoreline Management Act
9. Legislators
10. Most are already project partners, Puget Sound Partnership, WDFW, WDNR, DOE, UW researchers etc. DOT and county officials would benefit as well when making land use decisions.
11. All organizations and levels of government as well as Resource Commissions and citizen science organizations.
12. The public (!), State and local agencies responsible for land management and natural resources management. Land trusts and other conservation NGOs.
13. Most are aware and involved at some level.
14. Salmon recovery community, local and state level governments.
15. Policymakers, government officials, and the general public
16. Puget Sound Partnership, Washington Salmon Recovery Funding Board and associated local Lead entities, National Marine Fisheries Service, EPA, Washington Departments of Ecology, Fish and Wildlife and Natural Resources, NRCS, local Shoreline Management planners, land trusts with a focus on shoreline/wetland conservation, and potential investors or supporters.
17. mitigation banks
18. Land trusts, coastal county planners

Q21. Repeats request for contact information

Q22. Provision for contact information

Q23. Is there a question we have not yet asked that you think should be addressed as we begin this work?

1. No
2. It will be critical to turn the quantitative science into real information that public and policy entities can understand with recommendations for action.
3. no
4. Not now
5. no
6. No

7. how should blue carbon value be compared to other values? for instance, if we prioritize blue carbon services, does that mean we should pave over brackish and freshwater marshes that are net contributors to global warming? obviously not -- but that means we need to think about integrating multiple values and how each ranks in conservation/restoration decisions.
8. I would encourage you to think about how you effectively engage with a very solid, skilled salmon restoration/recovery community Puget Sound-wide, and introduce this opportunity to them and others who might need mitigation, or are interested in conservation beyond other purposes of salmon recovery. I'll be passing this survey along to some of my peers who are not on your email list.
9. No
10. No