

An aerial photograph of a coastal marsh landscape. The foreground shows a mix of brown, dry marshland and patches of green trees. A winding road or path cuts through the landscape. In the background, there are large bodies of water, including a prominent blue lake or bay, and distant land with more trees and some buildings under a clear sky.

MARSH RESILIENCE SUMMIT

PROCEEDINGS

February 5-6, 2019
Williamsburg, Virginia

Maryland Sea Grant
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The statements, findings, conclusions, and recommendations in this report are those of the author(s)/ participants and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

Cover photograph: Nicole Lehming, Maryland Sea Grant
Summit photographs: Aileen Devlin, Virginia Sea Grant
A pdf of the report can be downloaded from the web at: www.chesapeakebayssc.org

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INTRODUCTION

The Chesapeake Bay, the nation's largest estuary, experiences one of the highest rates of sea level rise in the United States. In coastal Maryland and Virginia over 1000 km² of tidal wetlands are at risk of various types of flooding and erosion in addition to other human-induced stresses. Scientists have shown that marshes can provide important ecological services including improved water quality, flood reduction through wave attenuation, erosion protection, and habitat for fish and wildlife. However, considerable uncertainty exists about how marshes will react to accelerating sea level rise rates and what role marshes might play in adaptation planning for the surrounding communities, be it: urban centers, rural communities, or agricultural lands. What are the primary threats against marshes and what management strategies may help them survive? What benefits accrue by saving marshes and what are associated costs?

Marshes are dynamic systems. To track their response to climate change and other impacts, scientists use a variety of different metrics such as: vegetation cover and composition, change in elevation, and water quality and meteorological records. The Chesapeake Bay Sentinel Site Cooperative (CBSSC) is a collection of protected areas and research sites that provide intensive studies and sustained observations to detect and understand changes in coastal ecosystems. The CBSSC network of federal, state, and local partners aims to integrate science findings from local observations to improve planning and management decisions regarding sea level rise and ecological changes.



In 2018, the CBSSC management team recognized the need for a multi-faceted, regional discussion on marsh resilience in relation to sea-level rise in the Chesapeake Bay. To address this, the CBSSC proposed holding a Marsh Resilience Summit (Summit) with the following goals:

1. Present the latest science on the current and anticipated status of coastal Maryland and Virginia marshes and the associated human dimensions of marsh change.
2. Use feedback from attendees to identify priorities and next steps to improve marsh and coastal community resilience.
3. Strengthen the CBSSC network to effectively collaborate and implement marsh and coastal community resilience needs identified at the Summit.

In addition, the Summit would advance the work of the CBSSC by:

1. Attracting a broad, multi-disciplinary audience who would become more aware of the CBSSC's mission and current efforts to understand marsh resilience across the Bay.
2. Strengthening existing relationships and developing new partnerships to increase the CBSSC's network connections and resources.
3. Identifying potential new topics for the CBSSC to pursue in coastal resilience.

The CBSSC's Coordinator led a 15-member Summit steering committee to assist in the design of the meeting's structure, goals, presentations, and facilitated discussions. The committee recognized the value

in bringing together communities, scientists, and managers to discuss the latest science, challenges, and opportunities to increase marsh resiliency in the face of sea level rise. By holding the Summit, the CBSSC thought an exchange of information among the attendees would inject new energy into the implementation of existing adaptation plans and inspire more effective and inclusive marsh resiliency projects.

The Summit consisted of eight themed sessions:

- Marsh Migration
- Environmental Market Mechanisms and Other Conservation Policy Opportunities
- Linking Wetland Conservation and Community Resilience
- Co-Benefits of Marsh Conservation
- Lessons Learned from Management Techniques and Restoration
- Dredge and Beneficial Use
- Lessons Learned on Living Shorelines and Thin Layering
- Marshes, Agriculture, and Industry

Each session had five 15-minute presentations followed by 40 minutes of facilitated group discussion (about 15 people per group) based on a series of questions the sessions' presenters developed with steering committee members prior to the conference. Notes and specific recommendations from all the sessions were compiled and annotated (Appendices E–L).

On February 5–6, 2019, the CBSSC, with significant support from Maryland Sea Grant and other sponsors, hosted its first Summit for communities, scientists, and managers in coastal Virginia and Maryland. The Summit was held in Williamsburg, Virginia. It attracted approximately 230 attendees, representing 115 different organizations. The Hon. Rob Wittman, U.S. Congress, the First District of Virginia, and Ben Grumbles, Secretary, Maryland Department of the Environment, provided opening remarks at the start of the Summit.

The Summit's compilation of presentations and guided discussion questions centered around the impacts of changing marsh landscapes on natural and developed communities. As noted at the meeting, the Chesapeake Bay has some of the highest rates of sea level rise on the Atlantic Coast. As such, tidal wetlands and the ecosystem services they provide are increasingly vulnerable to decline via inundation and erosion. However, marshes may be able to withstand these threats through several geophysical processes including the ability to gain elevation through bioaccumulation and sediment supply and the ability to migrate upland. Human land use choices can disrupt these marshes' ability to store sediment and grow vertically, or to migrate horizontally over the land. For example, installation of sea walls may prevent marshes migrating towards the land and can cut off needed sediment flow to marshes. Conversely, a marsh's shift inland can encroach on other human land uses such as agriculture and residential communities. In this case, farmers, local governments, and residents must evaluate their choices to resist or adapt to a changing land type (i.e. from forest to marsh). Today, scientists, land managers, local governments, and residents must understand ways we can manage marsh extent and marsh quality, so as to minimize loss of marshes across the Chesapeake Bay region. As these landscapes change, we must prepare for legal and policy challenges, including issues of environmental justice for affected communities and economies. These were some of the key issues discussed at the Summit.

The purpose of this report is to: 1) provide concise summaries and recommendations from the Summit for the next steps towards improving marsh resiliency; 2) identify research, management, and policy priorities; and 3) highlight the CBSSC's role should play in the coming years to help implement some of the Summit's findings. The report appendices list members of the CBSSC management team, the Summit steering committee, participants, and detailed discussion notes from each Summit session (Appendix A–L).

STATE OF THE MARSH SESSION SUMMARIES

The eight Summit sessions are summarized below. Details of each session are provided in the appendices and author-approved presentations are available online (www.chesapeakebayssc.org/marsh-summit).

Marsh Migration

Talks in this session focused on marsh dynamics. Facilitated questions considered how to prioritize restoration and conservation efforts and identify possible knowledge gaps that may limit sound decision-making. Participants discussed relative sea level rise rates in the Chesapeake Bay and the potential influence of land subsidence and sediment supply on marsh elevation change. They considered how marshes move in response to changing water levels, especially in the face of barriers such as upland slope and bulkheads. There was further discussion on the role of floodplain ordinances, zoning setbacks, and buyouts as important legal and policy issues relevant to marsh sustainability (Appendix E).

Environmental Market Mechanisms and Other Conservation Policy Opportunities

Presentations and discussions investigated possible market mechanisms to incentivize marsh conservation. Topics included the current use of Total Maximum Daily Loads (TMDLs) credits and risk mitigation programs (e.g. Community Rating Systems; Vulnerability, Consequences, and Adaptation Planning Scenarios; etc.) to encourage conservation. Ideas still in development included carbon credits or “resilience credits” for marsh carbon storage (e.g. to mitigate climate change) or for potentially ensuring wetlands are maintained so their services (e.g. wave and flood attenuation, habitat) are not lost. There was overall discussion on other potential ways to value or monetize marsh ecosystem services depending on the user groups’ priorities (Appendix F).

Linking Wetland Conservation and Community Resilience

Research in this session detailed how sea level rise and associated marsh migration are causing a loss in property value, which could lead to property abandonment, especially as roadways and properties become more frequently flooded. The presenters noted that certain sectors of coastal communities experience greater socioeconomic risk than others. They expressed concern that low-resource communities are feeling politically marginalized without access to resources to protect their property. Presenters highlighted two organizations who are pursuing efforts to address wetland conservation. First, the Critical Area Commission is trying to integrate coastal resilience into the implementation of local jurisdictions’ Critical Area programs under Maryland’s Critical Area Law. Second, Virginia’s Sustainable Water Initiative for Tomorrow is addressing local land subsidence by replenishing the Potomac aquifer with highly treated water (Appendix G).

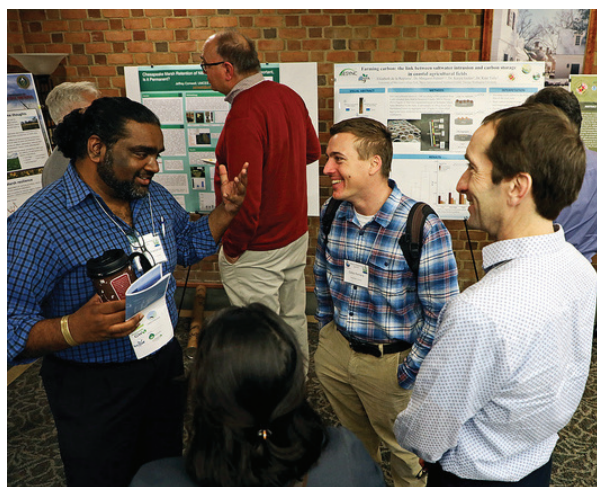


Co-Benefits of Marsh Conservation

Presenters shared a number of different benefits to preserving marshlands. Marshes can reduce storm surge through wave attenuation, improve water quality through nutrient uptake, sequester carbon, provide habitat, and improve human health (e.g. improve autoimmune response). One presenter highlighted how rapid marsh loss could risk extirpation or extinction of some bird populations. The group discussed how better coordination to quantify marsh conservation benefits may help the decision-making process and could improve communication about marsh value (Appendix H).

Lessons Learned from Management Techniques and Restoration

Talks in this session highlighted how to preserve marsh function through the recognition and preservation of several geo- and bio-physical processes. Important marsh attributes discussed included soil organic matter, soil microbial communities, nutrient availability in restoration sediments, fire effects on upslope migration, and the preservation of tidal channels, especially when remediating ditches (Appendix I).



Dredge and Beneficial Use

This session discussed how beneficial use of dredge material is an available restoration technique used to increase tidal wetland elevation. However, implementation remains complex due to site and material suitability, costs, and current policy regulations. The U.S. Army Corps of Engineers leads these types of efforts, collaborating with state and local partners to expand options for the beneficial use of dredged material (Appendix J).

Lessons Learned on Living Shorelines and Thin Layering

This session presented information about living shorelines and their ecological benefits when compared to shoreline armoring. It specifically highlighted the need for living shorelines to be properly designed for long-term resilience and the need for further social science research and community engagement to increase understanding and possible adoption of this restoration practice to combat shoreline erosion. Presenters also discussed promising restoration pilot projects in Chesapeake Bay marshes where thin layers of sediment from channel dredging sites are placed on top of an adjacent marsh to raise its elevation. However, discussants also noted there are still limitations to expanding thin layering as a marsh restoration tool due to issues with availability of appropriate sediment, marsh characteristics, sediment application, and permitting regulations (Appendix K).

Marshes, Agriculture, and Industry

This session focused on how sea level rise and saltwater intrusion are altering biogeochemical cycling in coastal farmlands and silviculture lands causing loss of productive timber and agricultural land. The group discussed ways to engage private landowners who are affected by loss of traditional crops. The discussants noted potential options and incentive programs (e.g. planting salt tolerant crops, tourism, land trust conservation, etc.) that could help industries continue to make a living off their land through alternative land use practices (Appendix L).

RESULTING PRIORITIES AND NEXT STEPS

The discussion sections tapped into the expertise and experience of over 200 marsh professionals. Summit participants identified collaboration needs, information gaps, cost-benefit analyses, and points of action to be considered in future efforts to address in marsh resilience. These are summarized below and detailed in the appendices.

Collaboration Needs

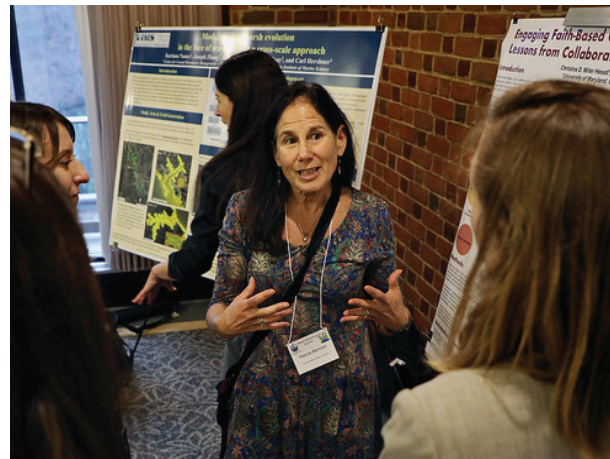
Strategic land use plans for marsh sustainability would be strengthened by including a diverse set of stakeholders throughout the planning process. Participants repeatedly stressed the importance of working with all interested parties from the beginning of any problem-solving effort to finding solutions that were acceptable to the stakeholders and would thus have a higher likelihood of being implemented and supported during the decision-making process. This collaborative process approach was discussed in multiple Summit sessions under a number of different problem-solving scenarios.

Support interstate, regional efforts

Regional collaboration on marsh conservation priorities could more strategically identify which preservation areas fit into larger, common goals such as storm protection, carbon sequestration (i.e. “blue carbon”), wildlife habitat, or other ecosystem services. Virginia and Maryland could both benefit from sharing information about their successful policies. Organizations that work across state lines may also benefit from interstate consistency.

Connect the state, the local government, and their stakeholders

There is significant variability among local governments within Maryland and Virginia because of differences in coastal landscapes, constituents’ priorities, and local laws and political structures. In some cases, for example, local governments have considerable jurisdiction over land-use decisions such as selecting grey vs green infrastructure. However, each local government is subject to their own governance structure, making it difficult to identify a “one size fits all” governance mechanism to ensure marsh resilience issues are considered in government decision-making. One option proposed at the Summit was to create a “marsh resiliency integrated committee” with representation from all stakeholder groups who could work within and across local government and communities to increase awareness of coastal resilience issues and develop useful approaches to increase resiliency. Another option was to strengthen state-level incentives for local governments to encourage adaptation of resiliency policies. Participants also noted a review, and, where necessary, adjustment, of existing permitting and other regulatory mechanisms that could remove unnecessary hurdles to managing marshes for resilience. For example, states could modify codes or laws if they impede proactive local government policies on resilience.



Assist underserved communities

Summit participants strongly supported engaging with underserved communities early on in any land-use and marsh resilience planning process. The group recommended honoring what communities know, starting the conversation by considering their core values, and integrating their voices into local and state land management decisions. Participants noted it is important to find ways to support these communities' efforts in marsh conservation and coastal resilience by providing them access to flexible financing information and technical expertise. For example, providing small communities with technical writing support could help them compete successfully for coastal resilience project funding grants.

Promote co-benefits among user-groups

The group recognized that particular marsh co-benefits (e.g. flooding protection, habitat value, improved water quality, human health benefits) could have more relevance to different user groups or stakeholders depending on their specific priorities and goals. While the group identified a need for a shared language and terminology, they also saw value in splitting messages among different user groups and strategically monetizing or incentivizing conservation actions or funds based on each user group's interest. For example, taxes on hunting equipment (hunters), issuing permits to support waterfowl conservation (bird watchers), or taxing anglers' equipment (fishers) to support wetlands conservation were presented as possible market mechanisms.

Establish interdisciplinary teams and projects

There was agreement that understanding multiple user groups' priorities and motivations and considering them in the design and/or implementation of projects would contribute to adaptation success (e.g. a co-production model). The group recommended that research teams investigating marsh resilience manage-



ment should be inclusive of natural and social scientists, regulators, planners, contractors, and community representatives. Many Summit sessions highlighted the need to include social science perspectives in marsh resilience planning. Some examples that require social science include: how people perceive and determine their support for restoration techniques (e.g. living shorelines, thin layering), under what conditions residents accept or resist community relocation, and how agriculturalists/foresters choose to manage loss of productive crop and forest lands.

Information Exchange

Summit participants discussed a gap that exists between available science and the information used to determine land management, policy, or community behavior change. Some scientists describe not having the resources to create outreach or education materials in addition to journal articles, technical reports, or datasets. Similarly, local government or community members expressed a similar lack of resources to obtain the necessary scientific information they seek.

Help users find answers to questions

Summit participants noted the availability of many reports, tools, and resources, but also stated that it remains challenging for end users (e.g. managers, policy makers, local government staff, NGOs, students, etc.) to seek out what is most relevant to them. Participants felt frustrated by the challenges of finding out what others have done to address climate resilience. They felt such information was important to know for guiding their marsh resilience actions in the Chesapeake Bay region, so they could learn from others what approaches could be successful. For example, it is difficult to learn about the range of climate-action tools or examples of different comprehensive plans, as well as the availability of, and lessons learned from,



monitoring data, restoration sites, and dredge sites across the region. Maryland Department of Natural Resources shared its BUILD, or “Beneficial Use: Identifying Locations for Dredge” tool at the Summit, and participants suggested expanding it to other regions. Several participants envisioned the convenience of a clearinghouse, one-stop shop, or “match-making” database to help users learn what is available (e.g. NOAA’s U.S. Climate Resilience Toolkit), though considerable effort would be needed to maintain its usefulness for stakeholders (e.g. do stakeholders know it exists, can they use it or provide feedback?). Possible ideas voiced by participants for clearinghouses included a “Craigslist” for dredge material, creating an “Angie’s List” for living shoreline contractors, and matchmaking between mitigation projects and property owners. Outreach professionals could also help end users find appropriate resources for their specific concerns.

Use trusted facilitators

The Summit participants identified a need for outreach professionals (e.g. “trusted facilitators,” “local resilience coordinators,” “community liaisons,” and “train the trainer leaders”) to improve coastal resilience adaptation. The group advocated for more persons dedicated to connecting end users and resources. This can include efforts such as understanding local community needs, helping communities engage with government, assisting with grant writing, identifying funding, training practitioners in best management practices and regulations, and science and tool translation and adoption.

Cost-Benefit Analysis for Coastal Land Use

Summit participants acknowledged that achieving a precolonial landscape is unrealistic, however meeting Chesapeake Bay restoration goals requires conservation, rehabilitation, and protection of the Bay's tidal wetlands. The Chesapeake Bay Program has a goal to "create or re-establish 85,000 acres of tidal and non-tidal wetlands and enhance the function of an additional 150,000 acres of degraded wetlands by 2025." The challenge is to identify which wetlands to conserve given differences among groups' (e.g. state and local agencies, environmental non-profits, land trusts, and property owners interested in easements) mission statements, values, and capacity (e.g. funds, labor, time). Factors that might contribute to the decision-making process could include: how long can specific wetlands persist with or without intervention, does the wetland have historic or cultural value, are there adjacent uplands with the potential to transition into marshes, will loss of the wetland result in lost ecosystem services (including habitat for threatened species) in the absence of quick action, what is the feasibility (e.g. effectiveness of restoration, costs) of one project over the other, and what are the impacts to surrounding land uses? Summit participants were concerned that they often lack sufficient data to help them make informed coastal land use decisions.

Better define the role of a migrated marsh

The Summit participants expressed concerns about the quality and function of a migrated marsh compared to its historic range. While marshes are ephemeral and have been transgressing inland since sea levels began rising 10,000–15,000 years ago, Summit participants expressed concern about how increasing rates of sea-level rise affect the rate of ecosystem response. Is sea-level rise accelerating so rapidly that the transition from upland to tidal marshes (i.e. marsh migration) is skipping several transition processes? For instance, skipped stages during transgression could result in loss of wetlands types (e.g. swamps, fresh water wetlands), tidal marsh zones (i.e. high versus low), marsh extent (acreage), and loss of ecosystem services provided by marshes. What role do invasive species play, *Phragmites* *sp.* in particular, in terms of biodiversity or other ecosystem services such as erosion control or nutrient uptake? While participants expressed uncertainty about the ecological condition of a migrated marsh, they questioned, if transgression occurs, what tradeoffs exist between the migrated marsh and the existing land use, such as agriculture or rural communities?

Ensure more cohesive, long-term monitoring

The group repeatedly highlighted the need for monitoring to further inform wetland conservation. This includes: 1) better quantifying marshes' ecosystem services as a way to market their conservation value, 2) observing the effectiveness of restoration techniques, and 3) observing marsh change over time, especially migrating marshes. While sentinel sites in the CBSSC and others research sites conduct core ecological monitoring long-term, the group emphasized the need to make monitoring more widespread and consistent. For example, accurate and routine marsh elevation and vegetation mapping are needed to understand marsh dynamics and aid marsh management. Access to private property for marsh studies and increases in resources to support monitoring would improve regional data collection and understanding of marsh dynamics. Also, continued efforts to support technology developments and innovation in monitoring approaches could potentially reduce costs while expanding monitoring capacity (e.g. unmanned aircraft or citizen science). Participants recognized on-going efforts (e.g. NOAA, state agencies) to standardize monitoring, but advocated for a universal set of criteria accessible through a centralized database or agency (i.e. a "Monitoring Corps"). Such a system could improve access to data and would allow for improved comparison of data among multiple projects and locations. That said, participants were realistic about the challenges and recognized that diverse sites will likely require different monitoring approaches, making "universal criteria" difficult to define and apply to all marsh monitoring data.

CHESAPEAKE BAY SENTINEL SITE COOPERATIVE FUTURE STEPS

One important goal of the Summit was to use information from the meeting to help inform future CBSSC efforts. The CBSSC's management team, and other partners and stakeholders, suggested several priority areas identified during the Summit that were particularly well suited to future efforts by the CBSSC.

Research opportunities

While the CBSSC is a ready conduit to share data between and among the network partners, CBSSC working groups are, more importantly, actively involved in the synthesis of shared data to generate broader understanding of Chesapeake Bay and the Nation's estuarine ecosystem responses to sea level rise and the impact of those responses on communities and built environments. Ongoing CBSSC work will integrate marsh vulnerability assessments among the sentinel sites and associated research partners (see Reay's "Assessment of Tidal Marsh Vulnerability to Sea Level Change within the Chesapeake Bay Sentinel Site Cooperative Network" presentation). As opportunities emerge, the CBSSC will expand natural and social science synthesis activities to: 1) extrapolate wetland condition and response to sea level rise from sentinel sites to sites without rich data sets, 2) determine rate changes in vertical land motion, 3) track marsh plant productivity to establish reference criteria for restoration efforts, 4) quantify rates of marsh transition into uplands and impacts on ecosystem functioning and services, 5) examine the social factors that influence stakeholders' decisions on coastal resilience and communication of sea-level rise impacts. Because the CBSSC is a distributed network of linked sites, it provides an ideal platform for assessments and investigations of sea-level rise rates and community impacts at both the site-specific scale and at the larger, Chesapeake Bay regional scale.



Making Scientific Information Accessible

The CBSSC recognizes that existing and new scientific findings must be readily accessible to managers, policy makers, private firms, and the public. One of the roles of the CBSSC coordinator is to facilitate dissemination of the information generated by CBSSC working groups to others, and to be knowledgeable about sources of education materials, interactive websites, or specific individuals or agencies with coastal resilience expertise or knowledge. While the CBSSC will continue to release technical results through webinars, infographics, and/or training, in the future CBSSC working groups will make greater efforts to inform a broader range of organizations, agencies, and individuals of CBSSC findings including groups that are less represented in resiliency discussions or outreach (e.g. including contractors in more green infrastructure training opportunities). Additionally, the CBSSC is cognizant of the need for consistent data collection methods, quality control, and management. Given that the Chesapeake Bay watershed spans six states and the District of Columbia, discussants recommended that guidelines be developed for interstate marsh conservation and monitoring programs.

Science, Management and Community Integration

Summit participants highlighted the need for entities to expand the conversation among multiple audiences about marsh migration and changing coastal land use as more land is inundated. As a “boundary organization” the CBSSC works with many partners interested in sea level rise at the Chesapeake Bay land–estuary margin. Using the CBSSC’s current and growing network of partnerships, including researchers and end-users, the CBSSC is well-suited to facilitate conversations and information exchange. An interdisciplinary committee of CBSSC partners would be well positioned to organize and convene a series of targeted workshops focused on a subset of high-priority marsh resilience issues identified during the Summit (i.e. conflicts with marsh migration, changing agricultural lands, ecotourism, comprehensive plans).

CONCLUSION

The Summit highlighted a number of pressing research needs spanning issues related to coastal resiliency to sea-level rise. These include the contribution of vertical land motion to sea-level rise rates; sediment dynamics in watersheds and wetlands (supply, deposition, source, and interactions with the biotic system); nutrient transport and transformations (especially microbially-mediated processes) in restored wetlands as these processes impact plant productivity and, consequently, sediment deposition and erosion; soil and sediment retention or release of nutrients; factors influencing landowners to choose a living shoreline; and establishment of effective communication networks. Participants highly valued hearing about current research and education efforts as well as discussing new collaborations and research directions. For example, the CBSSC added a new sentinel site as a result of the Summit. In fact, an overarching theme was a need for even greater engagement among researchers, government agencies, land-managers, policy-makers, NGOs, and other organizations to begin to break down barriers and identify opportunities to facilitate coastal resiliency projects. The Summit also revealed the inherent difficulties in uniting user groups who have different values and priorities, but have begun to build the transparency and trust necessary for collaboration to occur. The Summit fostered multi-faceted discussion over a range of resilience issues that will advance planning to increase coastal resiliency for the future.

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APPENDIX A

The Chesapeake Bay Sentinel Site Cooperative

One of five sentinel site cooperatives within the National Oceanic and Atmospheric Administration (NOAA) Sentinel Site Program, the Chesapeake Bay Sentinel Site Cooperative (CBSSC) is a regional network of scientists, coastal managers, decision makers, and community liaisons across Maryland and Virginia focused on integrating sea level rise science into stakeholder decision-making. The CBSSC includes a collection of “sentinel sites,” geographic locations where long-term coastal and environmental data collection allow for intensive research, outreach, and education on sea level rise and coastal hazards.

CBSSC Goals

1. Improve science-based capabilities for understanding sea level rise and its impacts.
2. Enhance and expand sea level rise partnerships to maximize the effectiveness of data collection, modeling, synthesis, and response to this information and translation through increased coordination and collaboration.
3. Foster resilience efforts that connect sentinel site data and products to local communities.

CBSSC Partners

The sites that are included in the CBSSC are listed below. More information regarding the sites can be found in the Chesapeake Bay Sentinel Site Cooperative brochure or the CBSSC website (www.chesapeakebayssc.org).

- Assateague National Seashore
- Blackwater National Wildlife Refuge
- Chesapeake Bay National Estuarine Research Reserve–Maryland (CBNERR-MD)
 - Jug Bay Wetlands Sanctuary
 - Monie Bay
 - Otter Point Creek
- Chesapeake Bay National Estuarine Research Reserve–Virginia (CBNERR-VA)
 - Catlett Islands
 - Goodwin Islands
 - Sweet Hall Marsh
 - Taskinas Creek
- Paul S. Sarbanes Restoration Project at Poplar Island (Poplar Island)
- Smithsonian Environmental Research Center (SERC)
- Virginia Coast Reserve Long-Term Ecological Research Site (VCR LTER)

CBSSC Management Team

Management team members consist of representatives from the sentinel sites as well as stewardship partners including Virginia Sea Grant, Maryland Department of Natural Resources, and the Virginia Department of Environmental Quality. The CBSSC Management Team guides and frequently participates in projects related to CBSSC goals. In February 2019, the management team was as follows:

- Linda Blum, *VCR LTER*
- Michelle Covi, *Virginia Sea Grant*
- Kyle Derby, *CBNERR-MD*
- Philippe Hensel, *NOAA, National Geodetic Survey (NGS)*
- James Holmquist, *SERC*
- Cora Johnston, *VCR LTER*
- Sasha Land, *Maryland Department of Natural Resources (MD DNR)/CBNERR-MD*
- Scott Lerberg, *CBNERR-VA*
- Patrick Megonigal, *SERC*
- Shep Moon, *Virginia Department of Environment Quality, Virginia Coastal Zone Program*
- Fredrika Moser, *Maryland Sea Grant*
- William Reay, *CBNERR-VA*
- Lorie Staver, *University of Maryland Center for Environmental Science (UMCES) Horn Point Laboratory*
- Court Stevenson, *UMCES Horn Point Laboratory*
- Mary Yates, *Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS)*

APPENDIX B

Marsh Resilience Summit Steering Committee

Steering Committee:

- Taryn Sudol, *Chesapeake Bay Sentinel Site Coordinator**
- Donna Bilkovic, *Virginia Institute of Marine Science*
- Michelle Covi, *Virginia Sea Grant**
- Kyle Derby, *Chesapeake Bay National Estuarine Research Reserve–Maryland**
- Jennifer Dindinger, *Maryland Sea Grant*
- Nina Garfield, *NOAA Office of Coastal Management*
- Keryn Gedan, *George Washington University*
- Sally Lawrence Wood, *Chesapeake Bay National Estuarine Research Reserve–Virginia*
- Erik Meyers, *The Conservation Fund*
- Shep Moon, *Virginia Coastal Zone Management Program**
- Fredrika Moser, *Maryland Sea Grant**
- William Reay, *Chesapeake Bay National Estuarine Research Reserve–Virginia**
- Suzanne Skelley, *NOAA Oxford Laboratory*
- Skip Stiles, *Wetlands Watch*
- Ariana Sutton-Grier, *The Nature Conservancy*
- Alexander Wooten, *Morgan State University*

*Also members of the CBSSC Management Team

APPENDIX C

Marsh Resilience Summit Agenda

Day 1 – Tuesday, February 5

7:45 a.m.	Registration Opens
8:30 a.m.	Welcome Fredrika Moser, <i>Maryland Sea Grant</i> The Hon. Rob Wittman, <i>U.S. Congress, the 1st District of Virginia</i> Matthew Strickler, <i>Secretary of Natural Resources for the Commonwealth of Virginia</i> Ben Grumbles, <i>Secretary, Maryland Department of the Environment</i>
9:40 a.m.	Introduction to the Chesapeake Bay Sentinel Site Cooperative and Summit Goals Jeff Payne, <i>NOAA Office of Coastal Management</i> Taryn Sudol, <i>Chesapeake Bay Sentinel Site Cooperative Coordinator</i>
9:55 a.m.	Assessment of Tidal Marsh Vulnerability to Sea Level Change within the Chesapeake Bay Sentinel Site Cooperative Network William G. Reay, <i>Virginia Institute of Marine Science; Chesapeake Bay Sentinel Site Cooperative</i>
10:20 a.m.	Break
10:40 a.m.	Understanding Sea Level Rise and Marsh Response Molly Mitchell, <i>Virginia Institute of Marine Science</i>
11:05 a.m.	Sea Level Rise and Migration of Coastal Ecosystems Matt Kirwan, <i>Virginia Institute of Marine Science</i>
11:30 a.m.	Leveraging Wetland Ecosystem Services to Protect and Restore the Chesapeake Bay Ellen Herbert, <i>Ducks Unlimited</i>
12:00 p.m.	Lunch

Day 1 Sessions

	DOGWOOD ROOM	OAK ROOM
1:00–2:50 p.m.	Marsh Migration <ul style="list-style-type: none"> GPS as a tool to estimate vertical land motion in local sea level rise Philippe Hensel, <i>NOAA NGS</i> The importance of watershed sediment supply to tidal wetland resilience to sea level rise Greg Noe, <i>USGS</i> A paradigm shift: re-thinking <i>Phragmites</i> (and <i>Phragmites</i> management) in the context of ecosystem resilience Thomas J Mozdzer, <i>Bryn Mawr College</i> 	Environmental Market Mechanisms and Other Conservation Policy Opportunities <ul style="list-style-type: none"> TMDL credit for marsh creation Pam Mason, <i>VIMS</i> Funding Resilience: The need for a natural resilience proposal Ross Weaver, <i>Wetlands Watch</i> Coastal Blue Carbon: Connecting conservation to carbon finance Stefanie Simpson, <i>Restore America's Estuaries</i>

	<ul style="list-style-type: none"> Barriers to marsh migration Carl Hershner, <i>VIMS</i> A bigger picture: Planning and zoning tools to manage retreat Katie Spidalieri, <i>Georgetown Climate Center</i> 	<ul style="list-style-type: none"> Potential for using resilience credits to protect and restore marshes Emily Landis, <i>The Nature Conservancy</i> Insuring Natural Infrastructure: Potential Application to Marshes Mark Way, <i>The Nature Conservancy</i>
2:50 p.m.	Break	
	DOGWOOD ROOM	OAK ROOM
3:10–5:00 p.m.	Linking Wetland Conservation and Community Resilience <ul style="list-style-type: none"> Underwater: Rising seas, chronic floods and the implications for the Chesapeake Bay Shana Udvardy, <i>Union of Concerned Scientists</i> Modeling property abandonment driven by recurrent flooding in a coastal locality Pamela Braff, <i>VIMS</i> Marsh Migration and Human Relocation: Finding a fair path forward Elizabeth Van Dolah and Christy Miller Hesed, <i>Deal Island Peninsula Project, University of Maryland</i> Integrating coastal resilience into Maryland's Critical Area Law Kate Charbonneau, <i>Maryland Critical Area Commission</i> Aquifer Replenishment and Land Subsidence: A SWIFT Perspective Dan Holloway, <i>Jacobs</i> and David Nelms, <i>USGS</i> 	Co-benefits of Marsh Conservation <ul style="list-style-type: none"> Storm surge and wave attenuation benefits of marshes in the Chesapeake Bay Celso Ferreira, <i>George Mason University</i> Characterizing the role of Jug Bay Wetlands on the water quality of the Patuxent River Patricia Delgado, <i>Jug Bay Wetlands Sanctuary</i> Year 1 of The Coastal Carbon Research Coordination Network David Klinges, <i>Smithsonian Environmental Research Center</i> Marsh conservation and bird populations in Chesapeake Bay Bryan Watts, <i>College of William and Mary</i> Human Health Benefits of Coastal Wetlands Ariana Sutton-Grier, <i>The Nature Conservancy</i>
5:30–7:30 p.m.	Poster Session and Evening Reception	

Day 2 – Wednesday, February 6

8:00 a.m.	Registration Opens
8:30 a.m.	Legal and Policy Challenges for Future Marsh Preservation Elizabeth Andrews, <i>William and Mary Law School</i>
8:55 a.m.	Marsh Roles in the Chesapeake Bay Model Lew Linker, <i>Chesapeake Bay Program</i>
9:20 a.m.	Pre-salted Beans: Sea level rise, marsh migration, and agriculture Keryn Gedam, <i>George Washington University</i>
9:45 a.m.	A New Kind of Wild: Reshaping the Gulf of Mexico After the Deepwater Horizon Oil Spill Bethany Kraft, <i>Volkert, Inc.</i>
10:10 a.m.	Break

Day 2 Sessions

	DOGWOOD ROOM	OAK ROOM
10:30 a.m.– 12:30 p.m.	Lessons Learned from Management Techniques and Restoration <ul style="list-style-type: none"> Vegetation and soil development in restored tidal freshwater wetlands: Lessons from the Anacostia and Patuxent estuaries Andrew Baldwin, <i>University of Maryland</i> Fire effects on ecosystem functions along a coastal elevation gradient: Implications for marsh resilience to sea level rise Julia Cherry, <i>University of Alabama</i> Enhancing tidal hydrology at Farm Creek Marsh Erik Meyers, <i>The Conservation Fund</i> Dave Curson, <i>Audubon Maryland-DC</i> Salt marsh restoration: Lessons learned and looking forward Erin McLaughlin, <i>Maryland DNR</i> Dredged material for tidal marsh restoration: Lessons from Poplar Island – the importance of nutrient availability Court Stevenson and Lorie Staver, <i>UMCES Horn Point Laboratory</i> 	Dredge and Beneficial Use <ul style="list-style-type: none"> Case Studies: Working with the U.S. Army Corps of Engineers Monica Chasten, <i>USACE</i> Tools for evaluating beneficial dredge material use and building marsh resilience Scott Hardaway, <i>VIMS</i> BUILDing resiliency: Maryland DNR approach to beneficial use of dredge material Jackie Specht, <i>Maryland DNR</i> Virginia's regulatory framework for dredging and beneficial use of dredged materials Tony Watkinson, <i>Virginia Marine Resources Commission</i> Opportunities for building marsh resilience in Virginia: A local government perspective Lewie Lawrence, <i>Middle Peninsula Planning District Commission</i>
12:30 p.m.	Lunch	
1:30–3:30 p.m.	Lessons Learned on Living Shorelines and Thin Layering <ul style="list-style-type: none"> Living shorelines: Long-term resilience and encouraging use Donna Bilkovic, <i>VIMS</i> In the face of sea level rise: Lessons learned restoring living shorelines in the Elizabeth River Joe Rieger, <i>The Elizabeth River Project</i> Thin layer placement as a tool to address impacts to coastal marsh habitat due to sea level rise – Case studies and future considerations Sam Whitin, <i>EA Engineering</i> Using sediment enhancement to build tidal marsh resiliency on Blackwater National Wildlife Refuge Matt Whitbeck, <i>Blackwater NWR</i> 	Marshes, Agriculture, and Industry <ul style="list-style-type: none"> Facilitating the transition from coastal agricultural land to high salt marsh as sea-level rises Linda Blum, <i>University of Virginia</i> Agroecosystems in transition: Sea level rise and saltwater intrusion alter biogeochemical cycling in coastal farmlands Kate Tully, <i>University of Maryland</i> Developing a saltwater intrusion plan for Maryland Jason Dubow, <i>Maryland Department of Planning</i> Impacts of salt water intrusion on pine systems Matt Hurd, <i>Maryland DNR</i>

- | | |
|---|--|
| <ul style="list-style-type: none"> • Living shorelines: Understanding shoreline management decision-making
Sarah Stafford, <i>William and Mary</i> | <ul style="list-style-type: none"> • Engaging Private Landowners to Accelerate Wetland Restoration to Meet Clean Water and Coastal Resilience Goals
Amy Jacobs, <i>The Nature Conservancy</i>
Mike Dryden, <i>The Nature Conservancy</i>
Margot Cummings, <i>Chesapeake Research Consortium</i> |
|---|--|

3:30 p.m. **Break**

3:50–5:00 p.m. **Wrap Up Discussion and Prioritizing Next Steps Forward**

APPENDIX D

Marsh Resilience Summit Participants

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APPENDIX E

Marsh Migration Discussion Session Notes

The notes in this appendix capture the views expressed by participants in the breakout discussion groups for this Marsh Resilience Summit session. We present them with little editing based on the notetakers' records in each breakout group. The discussion questions, which were developed before the meeting by the session organizer and the speakers in each session, are provided below followed by the discussants' comments. Because of time constraints some of the discussion questions were either not addressed or only discussed briefly. The intent of providing these notes in the appendices is to reflect all stakeholders' feedback and to highlight the diversity of input and exchange at the Marsh Resilience Summit. Please note that the views below are of the participants and not of CBSSC and/or Maryland Sea Grant.

Discussion Question 1: If whole scale marsh migration isn't possible, then potentially less optimal options may be the solution. These might include: *Phragmites*-dominated wetlands; smaller, engineered habitats such as living shorelines; engineered wetlands, or lack of action due to conflict over restoration choices (e.g. critical species habitat vs. nutrient filtering capacity). How are different priorities resolved with limited funding and limited availability of land? How are these tough decisions handled in a just/equitable way? Science will only inform the specific questions asked. Who decides which questions get asked, then? How do we prioritize them? Who should inform the responses? Who needs to be at the table? How do you ensure the result is truly supported by the community?

- Need community buy-in/stakeholder involvement.
 - A recognition of tradeoffs
 - Timescales for inundation may differ between communities and marshes.
 - Stakeholders will have differing priorities and goals (process depends on goals) and potentially different outcomes such as:
 - Property values so low they can't move. Speculators taking advantage of people leaving.
 - Gentrification and environmental justice issues arise.
 - Incentives needed to take a long term view.
 - Use a Clean Water Act framework to balance stakeholders and science.
 - It is a hurdle for people to realize or agree to use their property differently.
 - In Virginia it is legally required to incorporate sea level rise into comprehensive planning. Bring in public comment.
 - Create liaisons between science, management, and stakeholders.
 - Stress multiple benefits of practices/protection.
- Incentive or monetize to increase jurisdictions meeting total maximum daily loads (TMDL) or nutrient credits.
 - Local goals are tied to TMDL regulations.
 - Path of least resistance may be through regulatory (e.g. flooding) or watershed action plans. It's difficult to include migration into design.
- Framework to link science and management.
 - Only landowners and regulators at the table

- Community needs trust to allow marshes to migrate.
 - Nonprofits work with private landowners.
 - Link biology and engineering
- Need political support/buy-in especially in local government.
 - Local government has considerable control over land use decisions and positions.
 - Lewie Lawrence/Public Access Authority has an existing model for funding positions.
- Policy can hinder activities or new ideas.
 - Regulations don't include needed behavior changes.
 - Need to build resiliency into city codes.
 - Need inspectors for local best management practices (BMP) that are trained and allowed to track status.
- Interstate cooperation
 - Bay-wide approach to better identify potential restoration sites (such as thin layering)
- Education—politicians, landowners
- Are there places that are failing that we are investing in? How long of a time scale do we need to decide to not invest in an area that is going under water in the near future?
 - The services we see in wetlands developed over a long timeframe.
 - Sustainability could be most important to not waste money or effort.
 - Need to consider uplands, sediment supply, vertical land motion, animal species, and cultural values.
 - Need to consider many ecosystem functions (some of which compete with one another).
 - Need Light Detection and Ranging (LIDAR), good underlying data, models, monitoring.
 - What's the difference between a migrated marsh versus the original?
- Rolling Resource Protection Areas (Virginia Chesapeake Bay Preservation Act): Can it be done?
- Agriculture fields are less likely to be protected than homes. Taxpayers may not want to subsidize land protection, but localities get high tax revenues from those lands. Maybe ecotourism can be a tradeoff?
- There is a real need for long-term funding to enable management and monitoring. There is a reluctance to put money towards research instead of outcomes.

Discussion Question 2: Are alternate stable states (e.g. *Phragmites*-dominated ecosystems) a viable option to meet management and policy objectives related to ecosystem resilience? How do we prioritize restoration and conservation efforts to support wetland migration given spatial and temporal variability in sediment supply across locations within estuaries (given the importance of sediment supply to existing and future wetlands in the face of sea level rise)?

- More research on *Phragmites*: what does a healthy *Phragmites* marsh look like?
 - Effect on *Spartina* in ghost forests
 - Impact on birds (is *Phragmites* poor habitat or will wading birds use for cover?)
 - Is *Phragmites* best in areas already heavily stressed?
 - Get a sterile variety that can't reproduce.
 - Native *Phragmites* for restoration?
- Has anyone measured the amount of sediment coming into the Bay? Is it too much or too little? What about the type of sediment?

Discussion Question 3: What are the remaining gaps in our knowledge to inform decision-making as related to land use planning, community resiliency, and wetland ecosystem resiliency? Can we develop an agenda and/or priority list to address them?

- Cost-benefit analysis including cost of doing nothing
 - Bang for buck. Be strategic on where to spend scarce dollars. Requires assessing resources.
 - Balance between use of services provided and risk of marsh loss to maximize function
 - Trade-offs between built and natural resources
 - What comes first, the goal or money? Do what you can with available money or get the money necessary to meet the goal.
 - “Realistic” goals
 - Which organization is providing funds?
- Alliance for the Chesapeake Bay
 - Conserve Virginia Department of Conservation and Recreation-tool: Where to spend limited dollars.
- We need a better handle on stormwater management and undersized facilities due to climate change.
 - Concerns about groundwater and saltwater intrusion to wells. This needs to be part of planning. There is limited room to accommodate and absorb rainwater.
- Don’t forget riparian buffers. Without marshes, they’re more important.
- Too many tools
- Interview people who have lived in area for generations (i.e. “High Tide in Dorchester”) to help fill in knowledge gaps.
- Trajectory of different types of marsh and stable states
- What ecosystem services are provided at a new stable state?
 - Difficult to manage based on “stable-state” in a dynamic system with climate change

APPENDIX F

Environmental Market Mechanisms and Other Conservation Policy Opportunities Discussion Session Notes

The notes in this appendix capture the views expressed by participants in the breakout discussion groups for this Marsh Resilience Summit session. We present them with little editing based on the notetakers' records in each breakout group. The discussion questions, which were developed before the meeting by the session organizer and the speakers in each session, are provided below followed by the discussants' comments. Because of time constraints some of the discussion questions were either not addressed or only discussed briefly. The intent of providing these notes in the appendices is to reflect all stakeholders feedback and to highlight the diversity of input and exchange at the Marsh Resilience Summit. Please note that the views below are of the participants and not of CBSSC and/or Maryland Sea Grant.

Discussion Question 1: What info is needed by decision makers (at any scale) to better include marshes into decisions about coastal land use including how to plan for future marshes?

- Foster stronger connections among state and local governments and residents. Different groups value different things, so know your audience but also find commonalities of needs and wants among the groups.
 - For example, in Virginia, some localities did not realize they may be eligible for TMDL (Total Maximum Daily Loads) credits for building living shorelines.
 - The benefits of TMDL credits could be enhanced by encouraging living shorelines at a city level.
 - NOAA is looking at how much shoreline is needed to maintain or support ecosystem health. The results can be provided as direct outputs to decision-makers and planners.
- There are challenges in communicating with elected officials.
 - Elected officials may be unfamiliar with sea-level rise projections or ecology.
 - Elected officials may benefit if they were given tours of the marshes to help them understand marsh ecology.
 - Elected officials' role is to be responsive to their constituents. Conservation priorities or messages may resonant to officials more if property owners, taxes, and watermen relay these messages to them.

Discussion Question 2: How can we better engage with the private sector on increasing marsh resilience?

- Watermen or insurance companies could make good messengers to talk with officials (in addition to scientists) to support conservation co-benefits.

Discussion Question 3: Who, if anyone, values marshes enough to be willing to pay for an insurance policy to protect them?

- Who will pay to restore or insure coastal habitats in rural areas?
 - Create a methodology for interested parties to pay property owners for protecting or restoring at risk areas. The challenge is finding a funding source
- Local governments face a “Buy-out” dilemma when coastal lands face frequent inundation because if they pay people to leave, it is a loss to their tax base. Some land types may be better for buy-out than others, such as land used for cattle or non-residences.
- It is important to consider institutions that have large facilities and workforces, such as the Navy bases, that can benefit from shoreline protection.
- Also engage hotels, tourism, insurance, farmers, or organizations that value and may benefit economically from the cultural heritage of a place.
- Economics of blue carbon projects are compelling to communities and stakeholders.
- Market ecosystem service messages among different user groups and monetize/incentivize appropriately. We can work with hunters, anglers, etc. to support conservation.
- Living shorelines
 - Homeowners often choose not to build living shorelines, which could indicate that social marking might be a good platform to increase living shoreline implementation.
 - Some homeowners seem to respond to erosion more than to wetland loss.
 - Some homeowners like seeing an immediate return of investment on infrastructure (such as shoreline armoring).
 - In order to change a norm, the norm may need to be reframed: Homeowners don't need to be paid to protect the waterfront, homeowners have the responsibility and public trust to protect it.
 - What is the role of the state (e.g., Virginia Marine Resources Commission (VMRC)) in supporting projects when people cannot or will not build living shorelines? The waterfront is partially in state waters and could be a state responsibility.
- There are unknowns and questions regarding the feasibility of creating marsh insurance.
 - How do you quantify the co-benefits for insurance purposes?
 - It might be possible to come up with numbers for sea grass, blue crab.
 - Who pays when you're working in lower economic areas? The state?
 - How do you quantify stress multipliers, not just a single storm event?
 - Is the insurance acting on philanthropic interests or integrating with a business model?
 - We can look to communities and organizations working in developing countries to see how they fund conservation efforts. Are there lessons from protecting coral reefs that are transferable to protecting marshes? Both are affected by gradual stressors.

Discussion Question 4: (If there's time). Do marshes suffer damage in severe weather? Are they repairable and is that expensive?

- Marshes are affected by both longer term (sea level rise) and episodic (storm events) stressors. This influences investments in marsh resilience.

Discussion Question 5: (If there's time). What particular aspects of ecosystem services are easiest to market, both in terms of funding and public appeal?

- Co-benefits require an interdisciplinary view which includes ecological, social, and economic considerations.
 - Seafood production is an important ecosystem service that derives from marshes. People can consider co-benefits of marsh creation and seafood.

APPENDIX G

Linking Wetland Conservation and Community Resilience Discussion Session Notes

The notes in this appendix capture the views expressed by participants in the breakout discussion groups for this Marsh Resilience Summit session. We present them with little editing based on the notetakers' records in each breakout group. The discussion questions, which were developed before the meeting by the session organizer and the speakers in each session, are provided below followed by the discussants' comments. Because of time constraints some of the discussion questions were either not addressed or only discussed briefly. The intent of providing these notes in the appendices is to reflect all stakeholders feedback and to highlight the diversity of input and exchange at the Marsh Resilience Summit. Please note that the views below are of the participants and not of CBSSC and/or Maryland Sea Grant.

Discussion Question 1: Some communities will have financing and tax base to do expensive adaptation projections, but what about the lower resourced communities? How do we help these? As a nation, how do we begin the conversation about ways to assist them?

- Change state criteria to put state-funded projects in these areas.
 - Innovative, flexible
 - Develop new funding strategies through critical areas.
 - Fee-in-lieu in some areas but fewer in low economic areas
 - It is hard to fund projects for communities without the technical resources and expertise to submit high-quality proposals.
- Funding mechanisms should be flexible
 - A climate alliance—get carbon credits to fund projects
 - Get money from greenhouse gas producers. Who is eligible?
- Consider community/university/NGO partnerships to bring expertise like technical resources to underfunded area to make high quality proposals. Listen to community needs. Ask what they need first.
- First determine collective cultural values, then engineer our way through.
- Conversations with communities can be unfair if resources are too limited or not available.
- Be prepared to share tough options.
- Why is relocation the only way? Can people live with the water?
- Expose problematic loopholes in laws.

- Need local resilience coordinator to understand local needs and communicate those needs to the state. Give them venues through which to be heard.
 - Use for funding opportunity outreach.
 - An anthropologic approach is necessary.
- It's important to involve lower resource communities and listen to what they know. Be there for the long-term. Get them in early. Example: "Oyster Futures" program.
 - Honor what communities know. Don't treat as "victim."
 - Smith Island: Original goal was to convince locals to leave. Now attempting to provide resilience to communities.
- Ways to create incentives for transfer of development rights (TDRs)
 - Pair with total maximum daily loads (TMDL) or other programs?
 - Dorchester County has been approached for buyouts.
- Use pilot projects to build trust.
- Critical area resilience projects raising roads with State Highway Administration (SHA) and living shorelines, etc.
- More holistic mitigation planning, not project by project
- VA Department of Housing and Community Development: 51% of projects must benefit low/moderate income communities and look at more resilience projects in the future.
- VA Department of Emergency Management mitigation money
- VA Master Coastal Resiliency Plan identifies vulnerable communities.
- Circuit riders for all critical areas, not just resiliency projects?
- Today people consider moving the norm, but historically people stayed much more local. Old locations can still have significance even when people move out.
- Press and social media coverage

Discussion Question 2: At what level do we see a need for more policy leadership on these issues -local? State? Federal? All? How can government employees, NGOs, and researchers better engage with rural communities to understand and meet their needs?

- All levels of leadership with lots of community input and include regional government discussions.
 - If laws impede local government action, then state should change code or law.
 - Higher levels of government may not have room for movement.
 - Even different agencies have a hard time agreeing on policy and priorities.
- Local governments should work with communities to form a solution.
- National level discussions about who helps pay for coastal area (e.g. Does Iowa pay for Virginia?).
- What's the tipping point where local/state governments stop managing infrastructure because not enough people live there anymore?
- For those that stay, what are the implications for health and safety and limited resources to keep them?

- Look at overlap between critical areas and socio-economic vulnerability.
- Improve science translation to communities.
 - Use research trips to talk to community members. Attend community meetings.
- Develop community liaisons positions. Identify resources, help with grant writing. Non-biased.
 - At what level? Local? Regional?
- Funding mechanisms
 - Increase who is eligible.
 - Waive match funds for under-resourced communities.
- Increase conversations between urban-rural areas and rural-rural areas.
- Current priorities are stopping erosion and protecting structures. Land gets lower priority.

Discussion Question 3: What information needs do people have? How are personal decisions about relocation and other adaptation measures made? How do people understand risk assessment? How do people choose to make one decision versus another? What other data needs do people have?

- Relocation considerations: Don't just transfer from one vulnerable area to the other.
- What should receiving areas look like?
- Recognize the inherent conflict caused when choosing different land uses such as protection of natural environments or people and property.
- Living shorelines versus bulkheads
- Show people their available options for staying/going.
 - Be realistic. Show gravity of the situation.
- People do not always trust the science being presented to them. They tend to believe more historical data than projections of the future.
- Does census data show where people are staying and leaving?
 - Length of ownership, age, commute time
- Costs associated with solutions
- Building uncertainty into models
- Clearinghouse for tools (i.e. a centralized online location that stores and likely sorts through available tools), coupled with community outreach
- Marsh migration versus encroachment: Note the connotative distinction between stakeholders who are interested in facilitating marsh movement and other stakeholders who see marshes overtaking their preferred land use.
- What are priorities for the infrastructure or properties we preserve?
- Need roving community planners who can circulate within a defined geographic region and provide additional assistance to local government staff and communities.
- It can be difficult to identify needs at the start of the project; you may have to continue to collect information while moving forward.

- The message being conveyed can be as important as the person sharing the information.
- Use technology (i.e. smartphone apps) to engage a community while collecting data.
- We have good information, we need funding.
- Not good at reaching people who are buying up coastal properties; developers buying up land (issues with grandfathering properties). Developers taking over buyouts and building on them. Once buyouts happen, what happens to that land? Redeveloping an area may lead to issues of social inequality and human displacement if land values increase.
- Encourage open space. If people retreat, the land can only be put under conservation easement. If you're going to use public money to preserve land or for buyouts, you need to make it publicly accessible.
- Consistent messaging through different means. Customize per community.
- Biggert-Waters Flood Insurance Reform Act is very attention grabbing. Federal law impacts state to local government.
- VA Department of Emergency needs a water agency department and increased capacity for new program development.
- CBSSC could help fund science translation to local communities.
- Scientists need to understand local perspectives.
- We have to better observe which demographic prefer to stay in their vulnerable properties and which demographic is more inclined to leave.
- If people know where and when it will flood they'll work around it.
- There needs to be a better understanding on how the length of time someone has lived on their property influences their tolerance of flooding and attitudes about solutions (e.g. bulkheads, marsh migration, living shorelines).
- Bulkheads—no insurance incentives
- Eastern Shore Climate Adaptation Partnership: Group discussions among leaders representing different communities on climate issues
- Connect vulnerable communities to people who have already had to relocate.
- Career development for locals to be trained and work in their communities. Ways to carry out livelihood under changing climate.
- TMDL—Some projects better served upstream but credits don't incentivize more work upstream. Incentivize up-state impacts. Need to talk about Chesapeake Bay west of I-95.
- Hampton and Earth Economics and Chesapeake Bay Foundation: assessing how projects help communities with multiple benefits and how costs are less than benefits.
- Floodplain info on Zillow or other real estate websites/apps

APPENDIX H

Co-benefits of Marsh Conservation Discussion Session Notes

The notes in this appendix capture the views expressed by participants in the breakout discussion groups for this Marsh Resilience Summit session. We present them with little editing based on the notetakers' records in each breakout group. The discussion questions, which were developed before the meeting by the session organizer and the speakers in each session, are provided below followed by the discussants' comments. Because of time constraints some of the discussion questions were either not addressed or only discussed briefly. The intent of providing these notes in the appendices is to reflect all stakeholders feedback and to highlight the diversity of input and exchange at the Marsh Resilience Summit. Please note that the views below are of the participants and not of CBSSC and/or Maryland Sea Grant.

Discussion Question 1: How do we make sure these ecosystem services (including habitat for imperiled species) are provided in the future? How do we scale up for conservation efforts beyond Band-Aid restoration efforts? What are our next steps or priorities?

- Better understanding of marsh changes. Maybe adapting our strategies based on marsh dynamics.
 - Be strategic about places to slow down loss or assist in marsh migration without losing marsh in the process.
 - Explore and be open to marsh management strategies. Previous effectiveness could change with current sea level rise and subsidence.
 - Need cross-discipline discussions.
 - Need to think about timing—is a parcel size X with a 30 to 50 year lifespan worth it?
 - Need larger scale conservation initiatives.
 - Need to be open and honest about limitations.
 - Maintain diverse elevations.
 - Fundamentally, we need to think about getting what we want out of the Bay in the future with sea level rise in play. Unrealistic to get to pre-colonial Bay.
- Create economic incentives.
- Cost benefit analysis of different ecosystem services
 - High quality, high feasibility
 - Hang onto best of the best.
- Have to look at zoning and development: brownfields, transfer of development rights, and easements. Maryland has a transfer tax for real estate sales.
 - Look to minimize future issues (dense communities adjacent to broad open space).
- Bird concerns:
 - Do you lose species with marsh migration? What if *Phragmites* moves in? How do species compositions change? Vegetation changes affect cover (open area of low marsh).

- What about berms and roads? Seek refuge in berms. Black rails have a stronghold in New Jersey, which has a system of roads.
- From a targeted species perspective: need more resources. How do we bring them back or provide the habitat they need?
- Thin layering: good for some species but not certain birds. Do a thin layer next to existing bird populations and see if they populate layered area.
- Remove federal subsidies in floodplains.
- Best management project funding but not for outreach efforts related to these
- Comprehensive plans usually incorporate environmental protections language at local level. Get language into property purchases.

Discussion Question 2: There is often a lack of monitoring both long-term and post-restoration. How do we leverage more resources for monitoring as well as make sure we're monitoring correctly and consistently across groups? Where else do we see research gaps?

- Increase developer fees and accountability.
 - Use for mitigation monitoring
- Include maintenance and monitoring in grant requirements.
- Citizen science/volunteer-based monitoring
 - Need reasonable, replicable methodology.
 - Leverage master gardeners, master naturalists, and retirees.
 - Increases financial efficiency
 - Need species specific attention (i.e. Black rail).
 - Crowdsource widely among citizen scientists and volunteers to collect data that amasses trends and information for widespread projects (e.g. tracking the performance of living shorelines, marshes that are not part of protected area or research site).
 - Need everyone on board with your objective.
 - Devise monitoring that any one can reliably collect with minimal training.
 - Expands scope
- Consistency and coordination in monitoring and management strategies
 - Hard to find funding for monitoring. Perhaps have developers pay.
 - Include in public/private grants
 - Need a dedicated funding source.
 - Put onus on grantee. Include a reward system where they would get funded again if monitored properly.
 - Leverage technology (drones).
 - Have grants last longer than 2 to 3 years.
 - Reduce protocols to minimum requirements, reduces cost and improve efficiency.
 - What species do you select?
 - But diverse sites may need different approaches
 - How long do you measure success?
 - Contractors hire out monitoring. This does not always useful data.
 - Can pay fee in lieu of monitoring for efficiency of restoration projects.
 - Need coordinator to pull data together.
 - Also include residential lands (i.e. living shorelines) but understaffed and underfunded.

Discussion Question 3: Marshes are at the interface of terrestrial and marine landscapes and built communities and natural ecosystems. How do we facilitate conservation between these interfaces? How do we communicate marsh benefits?

- Public education efforts on all levels and across multiple fields
 - Put research dollars in understanding public values.
 - Provide education early, often.
- Better understand and communication of co-benefits; cross-discipline discussions; open, honest, and open-minded discussions
- Targeted strategies: stakeholder messages, location selections, larger-scale thinking and consideration of time scales.
 - General public on broader benefits of wetlands. How does this affect me?
 - Need to consider what wetland feature most appeal to the public. People like living aspects (though there is alarm over snakes); for example, Pennsylvania used otters for their conservation campaign.
 - Need fishers and anglers to talk to politicians.
 - Need a trusted facilitator. Fine line to remain objective. Maryland critical area commission community member?
 - Talk at retirement centers.
 - Whole context important. Some people are worried about bigger issues.
 - Try a positive outlook instead of doom and gloom. What we can gain instead of what we'll lose.
- Promotion of human benefits to citizens: health, hunting, fisheries, recreation, tourism, and beauty. Bring people into marshes. Get health community on board.
 - Audubon takes on tours.

APPENDIX I

Lessons Learned from Management Techniques and Restoration Discussion Session Notes

The notes in this appendix capture the views expressed by participants in the breakout discussion groups for this Marsh Resilience Summit session. We present them with little editing based on the notetakers' records in each breakout group. The discussion questions, which were developed before the meeting by the session organizer and the speakers in each session, are provided below followed by the discussants' comments. Because of time constraints some of the discussion questions were either never addressed or only discussed briefly. The intent of providing these notes in these appendices is to reflect all stakeholders feedback and to highlight the diversity of input and exchange at the Marsh Resilience Summit. Please note that the views written below are of the participants and not of CBSSC and/or Maryland Sea Grant.

Discussion Question 1: Who do we bring to the table in order to conserve/manage marshes holistically? How can we bridge between research and implementation? How do we balance interests among specialists/users with more single-minded goals?

- Local governments
 - Need to be included more
 - Politics are a significant factor.
 - Restoration/conservation needs to be linked to local plans.
 - Create “marsh resiliency integrated committee” with representation from all stakeholder groups. Improves perception of our work by the general public.
 - Local governments are a bridge between agencies and citizenry.
- Integration of science and management agencies
 - Some examples of this in Maryland and good links in Virginia Beach
- Clarification of goals will determine if we need or want restoration. The goals affect the monitoring data collected.
- Different groups/agencies will have different opinions and approaches.. Target different users based on the marsh ecosystem service that most appeals to them as well as the other multiple benefits of having a marsh (“co-benefits”). Communicate co-benefits to the public.
 - Ask the opposite side who is missing from gatherings and create focused sessions from this.
- Researchers don't always start out with implementation in mind. They're trying to answer a question.
 - Bring scientists and managers together at the start.
 - Funding specifications for research is an obstacle to link researchers to actual projects (some grants do require this).
 - Link social science to research projects to help with outreach (communication efforts and facilitated stakeholder process).

- Everyone (politicians/citizens, local groups) needs to be involved.
 - In urban areas you have to start with property owners.
- Publications of project summaries or guides would be beneficial to managers to keep up with trends, changes, and to share with residences.
- Expand work from public to private lands.
- Decouple regulatory aspect so private landowners don't think government involvement isn't just to increase regulation on private citizens.
- Community buy-in takes time to build trust.
 - Tell narratives.
 - Listen to communities. Learn their priorities. Start conversation from their core values. Integrate their voices.
 - Discuss tradeoffs and prioritize. At what point do we favor one ecosystem over another?
 - Use conceptual mapping to see how stakeholders view management of the system.
 - Build conceptual models with interdisciplinary group. Use multiple conceptual models to explore gaps in understanding.
- Who the stakeholders are depends on your context.
 - Resource users (farmers, fishers)
 - Economists conduct a cost-benefit scenario (short versus long term. Factor in intrinsic value, cultural services)
- Need common language, terminology.
- Move beyond zero sum management.
 - Managing along gradients rather than absolutes

Discussion Question 2: What are major knowledge gaps and how are we working to fill them? What do attendees view as priority research needs? What do we view as priority next steps?

- Knowledge gaps are often group specific. Stakeholders may be disconnected for a variety of reasons and not know where opportunities are.
 - Document all restoration projects and their locations.
 - Who maintains a data repository?
 - Include what hasn't worked.
 - Also needed for comprehensive plans
 - Ex. Climate Tool Kit model
 - Universal set of monitoring criteria to allow comparisons across projects and time
 - Lost in translation: There's information in reports (not peer reviewed) that isn't being shared. Difference between published and publicly available. Additional effort for researchers.
- Knowledge gap for freshwater marshes. Often where people are, there are many development pressures.
- Need social science.
 - Many people don't recognize the full range of wetland functions.
 - Hear cultural values from people.
 - Bring equity to the foreground. Lower income communities with less historic access to science.
 - Tax base. Who pays, where, in a just and fair way?
 - How do you prioritize a marsh when sea level rise is potentially threatening their homes?

- Where will development occur in 50 to 100 years?
- Allow for flexibility in restoration because these systems are so dynamic.
- Regulations process is slow and takes time for change. Maybe too strict and limiting (such as adoption of living shorelines). Cannot keep up with new technologies or ideas.
 - Also regulators have to remain an unbiased party even if environmentally-minded.
 - Lack a third party for education/awareness.
 - If rules allow for a waiver for a bulkhead, regulators have to allow for a bulkhead.
 - Limit how much can elevate bulkhead. This changes ability to withstand sea level rise.
 - Regulations most focus on current erosion rather than sea level rise impacts and future erosion scenarios.
 - Need to modify to assess and design long term change (50, 100 years?).
 - Enact regulations between mean level and mean high water.
 - A standard model would help. Create consistency and regulate state-wide.
- Lack of training and awareness among some contractors who install bulkheads
- Need a better definition of heterogeneity of marshes. This would help with scaling project up and management.
- Identify local drivers of restoration response (seed bank, hydrology). Each site will respond differently.
 - Is there a broad-scale restoration strategy that can be applied across landscapes or does each marsh require its own modeling and plan?
- How do you design current urban restoration projects so they can adapt or be modified with changing conditions (sand accretion, hydrology changes)?
- More research on localized subsidence
- Funding needs to allow for stakeholder engagement and monitoring.
- More focus groups/workshops with workable meetings will bridge practitioners and researchers. Group size should be small enough to not have the entire session just be presentations.
 - Series of smaller meetings with different priorities.
- Long term data (greater than 3 years) is needed, but who pays for it?
- Better understanding of the lifespan of restoration projects and whether the benefits achieved during that time justify the cost. How does sea level rise affect the lifespan?
- Giant sills are too big now, but it's unknown how they'll look in the future.
- Small canals limit living shoreline implementation.
- Increase incentives for farmers to retire salt-affected crop land.

Discussion Question 3: How does sea level rise create new challenges for these adaptation efforts?

- Sea level rise creates challenges for maintaining public access sites, which limits citizenry from using these open spaces.

Discussion Question 4: How are decisions being made about using resources to facilitate marsh resilience? What kind of policy or regulatory changes might be needed to improve restoration targeting for resilience?

- Projects with most resources tend to get the most funding. This limits underprivileged communities.
- How can NGOs and others help reallocate resources?
- State/local officials only respond to what applications are received. Need independent assessment on locations that need more restoration.
- Elizabeth River Project helps facilitate links and help low resource areas/people.
- Use zoning to determine rules and where to focus on resilience.
- Consider something simplistic such as, red, yellow, and green mapping of where living shorelines might be constructed.
- Coordination grants for bringing groups together and working towards data synthesis.
- Discuss evolutionary changes rather than just migration.
- Need to consider non-traditional funding sources.
 - Investment and return on investment are drivers.
- Need to include planning departments.
- More research on brownfields, transfer of development rights, and conservation easements to be used as sites for migration
- Funding for buy-outs, easements, and cost-sharing
- Adjust policies and regulations that inadvertently encourage development in coastal/floodplain areas.
- Involve planners.
- Involve permitting experts.
- Review boards hold considerable power and their composition likely influences the land use choices. Need more knowledge on how boards are appointed and function.?
- There is controversy on what level of advocacy a scientist should participate in.
- More flexibility for regulation community about “success” of restoration goals. Acknowledge system complexity and unknown future changes.
 - Are natural marshes always the best reference point for restoration?
 - How might alternative approaches to restoration, such as a series of small decisions and adaptive approaches rather than one fell swoop, be best considered?
- Matching funding opportunities with well-conceived shovel ready projects is sometimes challenging. Are there better ways to coordinate funding cycles and development of restoration projects? Planning grants? Longer time frame for proposal development?

APPENDIX J

Dredge and Beneficial Use Discussion Session Notes

The notes in this appendix capture the views expressed by participants in the breakout discussion groups for this Marsh Resilience Summit session. We present them with little editing based on the notetakers' records in each breakout group. The discussion questions, which were developed before the meeting by the session organizer and the speakers in each session, are provided below followed by the discussants' comments. Because of time constraints some of the discussion questions were either never addressed or only discussed briefly. The intent of providing these notes in these appendices is to reflect all stakeholders feedback and to highlight the diversity of input and exchange at the Marsh Resilience Summit. Please note that the views written below are of the participants and not of CBSSC and/or Maryland Sea Grant.

Discussion Question 1: What are the data and research priorities for expanding the use of dredge material for beneficial uses?

- Construction techniques: Keeping thin layer/dredge on the surface is difficult.
- Determine how to manage silt.
- How do you do thin layering at a small homeowner's site?
- Can you use little creek dredge material for little marshes?
- Can financing opportunities for beneficial use of dredge material be expanded?
- Participants had numerous questions about the process and regulations around dredge material management:
 - What is the dredge material's composition? Where it is coming from? If there are contaminants, what are they?
 - Do we know what the quality of the dredge material is at 5 meters deep? Can we get this information before we start dredging?
 - Do you need additional Environmental Assessment/Impact statements for going deeper?
- More evidence/studies on coastal bays to alleviate concerns about dredge projects, including:
 - Impact on water quality
 - Dredge material as a vector for invasive species (seed banks).
 - Design without taking away fish habitat
 - Dredging channels as conduits for salt water
- Chesapeake Bay National Estuarine Research Reserve–Virginia is studying impacts on plants/grain size.
- Database
 - Need a database of regionally organized data and each project's monitoring details.
 - Have a matchmaking “Beneficial Use: Identifying Locations for Dredge (BUILD)”-esque tool for Virginia. Build off Scott Hardaway's work. Link state dollars and local priorities.

- Identify public landholding sites and shoreline projects.
 - Compile where/when/how thin layering technique work and make available to decision makers.
 - Identify local natural resources, such as submerged aquatic vegetation.
- Need long term (5 to 10 year) monitoring.
- Solutions for timeline alignment (i.e. when dredge is available and when it is need for restoration).
- Create a “Craigislist” of dredge material like New Jersey (Note: The idea in New Jersey to help match dredging needs with marsh restoration/enhancement needs is still in its infancy).
- Research on communication/outreach for the public
- When do private entities dredge? Do we know what’s in it?

Discussion Question 2: How can dredging / beneficial use projects be funded and what are the key regulatory barriers to these projects?

- Maryland has state funding for shoreline projects. Virginia has a similar program but funding source hard to identify.
 - Maryland waterway improvement fund (from boat sales)
 - Virginia waterway maintenance fund, managed by port authority
- Communities have expressed that finding aid to help navigate the regulatory framework is a bigger challenge than generating funds.
- Can city money that goes towards programs like living shorelines also go towards thin layering or is it too experimental?
- Virginia tax overlay district of localities to tax watershed for dredging and maintenance. Need homeowner buy-in.
- Watershed organizations self-fund on the small scale. Have done dredge and used sand on Home Owner Association’s beach.
- Restrictions of where sand can be placed. Public/private land based on funding resources.
- US Army Corps of Engineers 100% federal funding
- Need for shared terminology across agencies and regulatory programs.
- Structure the projects for multiple benefits to take advantage of different pots of money.
- Do an “insurance policy” (The Nature Conservancy example in Mexico with coral reefs). Have a state fund that impacted properties could tap into.
- Raise taxes and use revenue to create conservation fund.
- Virginia has a fund where they assess mining permits. They were supposed to use it for dredging and beneficial use, but the money was not available for it. This mechanism is not being used.
- Federal navigation channels are not maintained anymore in certain places. Communities now responsible which creates permitting and financing challenges.
- Virginia Beach created “dredging districts.” Raised taxes.

Discussion Question 3: With regard to the use of dredge material, how do you balance the need for building resilience for coastal communities and protecting water quality through resource management programs when there are real or perceived conflicts between the two?

- In Virginia, a property's boundary extends far enough that many marshlands are privately owned. This means when you restore a marsh, you are negotiating with a private property owner rather than the state.
- Balance pros and cons of possibly improved marsh resilience via dredge with potentially impaired water quality due to dredge.
- Tax living shorelines, submerged aquatic vegetation, and fish habitats.
- Drying sediments before placement may affect existing contaminants.
- How do you contain the material? What are adjacent property owner reactions?
- Revised regulations needed to reflect recent developments in the science.
- Increase permit fees to monitor water quality.
- SAV is a challenge for permits.
- Can we treat toxic dredge?
- Which tradeoffs to make between different land uses or ecosystems services to preserve will likely depend on the site's specific characteristics?
- Determine dredging and marsh creation role in carbon cycling and storage.

APPENDIX K

Lessons Learned on Living Shoreline and Thin Layering Discussion Session Notes

The notes in this appendix capture the views expressed by participants in the breakout discussion groups for this Marsh Resilience Summit session. We present them with little editing based on the notetakers' records in each breakout group. The discussion questions, which were developed before the meeting by the session organizer and the speakers in each session, are provided below followed by the discussants' comments. Because of time constraints some of the discussion questions were either never addressed or only discussed briefly. The intent of providing these notes in these appendices is to reflect all stakeholders feedback and to highlight the diversity of input and exchange at the Marsh Resilience Summit. Please note that the views written below are of the participants and not of CBSSC and/or Maryland Sea Grant.

Discussion Question 1: What ways have been effective at enhancing the use and/or acceptance of natural or living shorelines? What hasn't been effective? What should be done that hasn't been done to increase use and/or acceptance? What types of incentives should we be offering property owners to install living shorelines or conserve lands that will be impacted by sea level rise?

- Lack of information
 - Put positive demonstration projects in public places.
 - Provide grants for living shoreline demonstration projects that can occur on private lands. Virginia does cost-share private property living shorelines but these are not necessarily demonstration projects in the traditional sense of anyone can go visit them.
 - Demonstrations on how they retain sediment, survive storms, and how they function overtime
 - Make them easily accessible and viewable; get them in "every neighborhood".
 - Neighbors and contractors' opinions matter.
 - Word of mouth supporting living shorelines can also be valuable.
 - Get contractors to visit the public demonstrations.
 - Need a trusted third party to make recommendations to property owners, such as NGOs and boundary spanning organizations.
- Education needs (for property owners and contractors)
 - What living shorelines are, how to put in place, how to pay for them
 - Shoreline armoring realities, such as expected lifetime for bulkheads before they fail
- Contractor education needs
 - Learn more what contractors' preference and typical recommendations are to their clients. Contractors may be key influencers in the homeowner's decision.
 - Challenging because sites vary.
 - It's a learning experience. Need capacity and have to build trust among contractors.

- Government can't tell property owner to get a second opinion if they think the contractor is steering them wrong.
- Could Chesapeake Bay Landscape Professional Program train the contractors?
- Effective permitting & implementation
 - If waivers are too readily accessible there is less incentive to enact living shorelines.
 - When creating living shorelines, put emphasis on planting low energy areas where low impact and low cost is possible.
 - Construction and NGO business may be a good way forward to recommend design/building approach to streamline projects.
 - Need long term monitoring which could be required by the permitting process. The monitoring should be more than plant survival snapshots.
- Virginia has authorized a tax exemption from property taxes for living shorelines.
 - Need information about taxing structures, etc.
- Branding/social marketing:
 - Embrace the natural environment. Focus on desirable wildlife (sea horses, crabs, charismatic megafauna).
 - Properly designed living shorelines should not require future mitigation.
 - Provide artistic renderings of how they'll look when built. Before and after pictures help.
 - Use co-benefits and indirect return on investment as an add-on of marketing.
- Property owner concerns often are about:
 - Increased mosquitos, snakes/alligators (but could keep them out of yard), and trash in marsh
 - Increased costs of living shorelines
 - Try cost-share promotions to help decrease costs for property owners. There are cost-share programs in Virginia for property owners that build living shorelines –more funding and resources (personnel) in the program would be a good step towards enhancing the use/acceptance of living shorelines.
 - Neighbor disagreements. Screening to block views of shoreline modifications can be used if neighbors are upset.
- Some available resources about living shorelines
 - Norfolk YouTube video on living shorelines
 - SEAS (Shoreline Erosion Advisory Service) program within VA Department of Conservation and Recreation

Discussion Question 2: With regard to the potential use of thin layering - is it acceptable to negatively impact marsh functionality over a relatively short period of time (i.e. ~5 to 8 years) with the intention of achieving long term success? What additional data do attendees wish to see in order to more definitively answer this question?

- Time scales
 - We are still learning how long it takes to restore marsh function. We can study older restoration projects to assess how long it takes for functionality to return.
 - When there are 5 to 10 years of problems or decreased effectiveness for marsh restoration using thin layering it can lead to negative perceptions and may look like failure.
 - Perceptions will be different depending on where (urban, residential, rural) and reporting, positive or negative by the press.

- Monitoring
 - Science understanding based on monitoring should continually be translated into policy changes that reflect new understanding.
 - Monitoring needs funding.
 - Could use citizen science on a small scale to monitor
 - Federal grants require public data sharing within 3 years. Require elsewhere too! We need easily accessible public data repositories for monitoring data.
 - Change permits to have longer monitoring and contingency plan.
- Installation process and design
 - Property owners and contractors need assistance with permitting. It's daunting.
 - Encourage people to talk about failures to improve design.
 - Testing different methods now. Try strips or donuts instead of large areas.
 - Timing is key. Stagger treatments to retain the deposition. Have 20% in transition at a time.
 - Need details about the amount of sediment in a successful marsh and if existing sediment conditions are appropriate.
 - Consider that costs not only include installation but also maintenance.

APPENDIX L

Marshes, Agriculture, and Industry Discussion Session Notes

The notes in this appendix capture the views expressed by participants in the breakout discussion groups for this Marsh Resilience Summit session. We present them with little editing based on the notetakers' records in each breakout group. The discussion questions, which were developed before the meeting by the session organizer and the speakers in each session, are provided below followed by the discussants' comments. Because of time constraints some of the discussion questions were either never addressed or only discussed briefly. The intent of providing these notes in these appendices is to reflect all stakeholders feedback and to highlight the diversity of input and exchange at the Marsh Resilience Summit. Please note that the views written below are of the participants and not of CBSSC and/or Maryland Sea Grant.

Discussion Question 1: How does the stress of saltwater intrusion and marsh migration on upland industries and agriculture differ from more well understood stressors, such as drought? How does our understanding of more well studied stressors inform our response to salt stress?

- Solutions and the issues themselves are on different time scales.
 - Salt water intrusion (SWI) is likely to be permanent, gradual, and predictable (where as drought is episodic, less predictable, but dealt with through irrigation).
 - Different stressors may still have similar impacts. Still hard to compare stressors.
 - Do plantings of salt-tolerant species still reach harvestable maturity before sea level rise (SLR) catches up?
 - Do we have inundation stress thresholds for certain species?
 - Mechanism of SWI is complicated with both saline flooding and salt and fresh water mixing in groundwater
- We don't know how the stressor applies spatially onto their landscape.
 - Has anyone mapped ditches e.g. through Light Detection and Ranging (LIDAR)?
- Lots of information and resources to help landowners address drought but less so for SWI and other newer issues tied to accelerating sea level rise.
 - Lack of research knowledge and lack of capacity
 - Need a lot of research for developing the appropriate program
 - Do we have contractors to carry out a program?
- Government programs could help develop genetic lineages of salt-tolerant crops/pines/etc.
- No natural recruitment of pines in lands affected by SWI. Seedlings died after 4 years of exposure to salt, not immediately after inundation.
- Farming a small area to deal with SLR isn't practical because affected areas are fragmented and make it difficult for farmers to manage field crops when the viable farmland in their fields becomes patchy due to SWI.
 - Precision farming might address this.

- What role does soil health play? Does healthy soil react as well as degraded soils? For example, salt can be tolerated, wet can be tolerated, but salt and wet is a huge challenge.

Discussion Question 2: What are the pros and cons of adaptation measures to saltwater intrusion? (examples include transitional crops, soil amendments, wetland reserve programs for agriculture, early harvest and special pest control measures for timber industry)

- Transitional crops
 - Do they exist? Can they be developed?
 - Nice that if there are transitional crops, they could be a viable short-term option
 - Need marketability and economic incentives.
 - Sorghum has been successful and well accepted in some areas but the market is not as strong as for other field crops (e.g. soybeans, corn, wheat).
 - Small parcel changes are difficult. Tend to farm all one crop in one area.
 - Farmers are adaptive over time. Small farms may be faster to change than large industrial farm models.
 - Some farmers lease marginal lands to specialized farmers.
- New crop option: Meet shortage of wetland plants for seed production.
- Wetland reserve programs
 - Limitations of reserve system may not appeal to landowners. Need flexibility.
 - Reserve programs pay more for prime land because of USDA programs. Farmers may not get much money for land that would be great for marshes. Need more financial incentives.
- Early harvest
 - Pro: Financial and potential safety benefits for reducing fire risks.
- Soil amendments
 - Gypsum can adsorb salt and phosphorus in the soil reducing effects on plants and runoff.
 - Biochar
 - Build up soil elevations.
- Have to find markets for actions taken to protect at-risk forests, marsh preservation, upland farming, etc.
- Pros/cons depends on goals:
 - The restoration/conservation stakeholders may differ in preference between protecting existing marshes and purchasing agricultural fields which will transition into marshland. What are the costs differences between these two options?
 - The farmers' goal maybe to preserve their cropland or generate income in an alternative way.
- Need for a cost-benefit analysis
 - Need long-term analysis. Will short-term solutions be irrelevant in 5 to 10 years and not worth the expense?
 - Costs for trying to keep things the same rather than incorporating adaptation strategies
 - Timing trade-offs between allowing trees/crops to mature for commercial profit versus not investing the time to grow them to maturity.
 - How do you time the harvest before it gets hit by SWI?
 - Early harvest of forests can be contrary to critical areas restrictions.

- Need for flexibility
 - Incorporating multiple ideas into existing adaptation funding
 - Adaptation measures are site-specific
- Make sure producers/farmers are “at the table.” They know the land.

Discussion Question 3: How can upland land users and property owners work to facilitate wetland migration, remove barriers, and compensate landowners? How can we communicate the need for these actions to landowners and also reduce their risk of catastrophic agriculture or industry failure?

- Engage farmers in restoration work and pay for those services.
 - Grading/re-sloping land could help marsh migration.
 - Burning? Re-establish natural processes.
 - Removing physical barriers such as berms
- As agriculture land is reduced, the agricultural community is reduced and made less powerful.
- Use the Farm Bureau for education
- One-on-one interaction with farmers leads to different results than group interactions.
 - Farmers use word of mouth to discuss things like this.
 - Use trusted messengers to provide education—ideally, someone local who understands the community.
 - Early adopters are important for showing proof of concept for farmland conversion.
 - Who knocks on the door matters. For example, people make judgements based on the academic institution a person may represent.
 - Establishing relationships with contractors can help make inroads with landowners.
- Need programs/solutions before we need facilitators of discussions. Infrastructure comes first. We lack landowner options/knowledge to give them.
 - Forestry service doesn't know what to do or say right now when pine landowners come to them with SWI issues.
 - Environmental Quality Incentives Program (EQIP) supports wetland creation and has fewer obligations but less money for farmers than CREP.
- Conservation Reserve Enhancement Program (CREP): More money, includes easements and time commitments. There are paperwork barriers. A trusted liaison with Natural Resources Conservation Service is super helpful. Need to set up a cost-share practice to allow for migration with some restoration management. Currently missing because it is currently considered as land going fallow.
- Alternative uses:
 - Leasing out land for hunting, ecotourism, oyster farming
 - Concerns about black duck protections
- Farm upland preservation: Set aside from development for future agricultural creation. Trade land to farmers losing land. Kind of like an agricultural bank/land trust idea.
- Deep till best management plans (BMP) in discussion. It would break up hard pan 18–25” down to increase water infiltration. This only works on certain soil profiles so not necessarily amenable on all vulnerable farmland.
- Wetlands Work website
 - How do landowners know they exist?

- Allow for trading in canopy percent cover between counties. Would need to manage carefully.
- Marsh scientists can benefit from talking to forest scientists.

Discussion Question 4: What are major knowledge gaps and how are we working to fill them? What do attendees view as priority research needs?

- How to find trusted messengers?
- Practitioner training such as permitting and understanding the landscape for both landowners, scientists, etc. Extension does this.
 - Use mediators, liaisons, train the trainers.
- What to do if people are living in unsafe (low-lying/flood-prone) areas and don't want to move?
 - Norfolk incentivizes living in safe places instead of penalizing living in unsafe.
- What can be done to help climate refugees whose homes will become unsafe in the next 5 to 10 years? Are there programs that can help them buy houses in better locations?
- Should we stop raising homes if roads and other infrastructure don't get raised?
- Chesapeake Bay Public Access Authority can donate small pieces of land (usually wetlands), which add up and can have a cumulative impact.
- Need matchmaking between mitigation projects/potential projects and property owners.
- Social science research and surveys: why aren't the incentive programs attractive to all landowners/farmers/producers?
- Revisit the vision and regulations often. Account for the dynamic nature of these systems and future projections.
- Farm Bill: Are farmers getting compensated for crop failures? Does crop insurance keep salinized land in production even under very low yields?
- Remove the need for crop insurance on farmlands to incentivize the farmer to look at what incentives are available.
- Need a county by county analysis (smaller scale) .
 - Better maps, including/integrated with groundwater
- Is the marsh we're gaining equivalent to the marsh we're losing?
- Soil studies in various zones/ecosystems (forest information)
- Guidance for producers to allow/facilitate marsh transitions
- Social dialogue: "We're not giving up on farms; we're gaining other valuable resources."
- Working in marsh migration for estate planning, generational successors
- Conservation Reserve Enhancement Program (CREP) Buffers: Lower transitional costs. Make incentives easier.