Environmental Management (2020) 66:407–418
https://doi.org/10.1007/s00267-020-01315-3

Coastal Stakeholders' Perceptions of Sea Level Rise Adaptation Planning in the Northern Gulf of Mexico

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Received: 13 January 2020 / Accepted: 9 June 2020 / Published online: 17 June 2020

Abstract

Planning for sea level rise (SLR) is a complex process that involves scientific uncertainty and local and regional political tradeoffs. As part of a 6-year transdisciplinary research project in the northern Gulf of Mexico, we conducted focus groups with coastal stakeholders (natural resource managers, community planners, and environmental communicators) to gain a better understanding of their planning and adaptation activities for SLR. This paper reports on participants' perceptions about adaptation and their current adaptation activities and strategies. While stakeholders were concerned about SLR and thought adaptation had challenges, they still shared optimism and a commitment to planning. The findings identify different types of SLR adaptation initiatives in which participants were involved as well as types of perceived barriers to adaptation planning, and major recommended strategies to address them. The paper concludes with a discussion of findings, connections to related SLR adaptation literature, practical implications for coastal resiliency, and directions for future research.

Keywords Sea level rise · Adaptation planning · Coastal resilience · Gulf of Mexico · Stakeholder perceptions

Introduction

Community planners, natural resource managers, and residents in many regions are grappling with sea level rise (SLR) and its effects on the coast. SLR impacts the built and natural coastal environment in multiple ways (Bilskie et al. 2014, 2016; Nicholls et al. 2018), including loss of cultural heritage sites (Marzeion and Levermann 2014), disruption to fisheries-dependent communities (Colburn et al. 2016), and migration or loss of coastal species (Alizad et al. 2016; Reece et al. 2013). The precise magnitude of SLR and its concomitant effects will vary based on local hydrological and geomorphological conditions (Passeri et al. 2015). However, even if global temperature increase is limited to 1.5 °C, SLR will continue until at least 2300 AD (Nicholls et al. 2018). Coastal planners and land and infrastructure managers must therefore respond to the current SLR-related threats that are becoming more frequent and plan for long-term continuance or intensification of these trends.

The purposes of this paper are twofold: (1) to present SLR planning and adaptation activities and strategies and perceptions about planning from the perspective of stakeholders in the northern Gulf of Mexico; and (2) to contextualize regional response to SLR within the global interdisciplinary literature on SLR adaptation. We report on results of six annual focus groups with individuals professionally involved in coastal natural resource and infrastructure management, community planning, and environmental outreach and communication (herein called "stakeholders"). The focus groups were conducted during a transdisciplinary project, Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico (EESLR-NGOM) that involved developing SLR models and interactive decision-support tools for coastal wetland habitats along the northern Gulf (DeLorme et al. 2016; Hagen et al. 2017; Kidwell et al. 2017). The focus groups were designed to improve communication among project scientists and community stakeholders, identify stakeholders' information needs, and understand stakeholders' broader concerns about SLR adaption planning. Our findings pertaining to stakeholders'

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information needs and their recommendations for public communication about SLR appear elsewhere (DeLorme et al. 2018a, b). Here, we report specifically on the actions stakeholders were taking at the time of the study regarding SLR planning and adaptation, and discuss their ongoing professional views about SLR planning and adaptation in the context of other research on adaptation barriers and strategies.

Literature Review

Planning for SLR involves a number of considerations, including various types of public infrastructure (Rosenzweig et al. 2011), private property ownership (Moser and Luers 2008), coast-dependent industries such as fisheries (Colburn et al. 2016), and the overall integrity of coastal ecosystems (Voss et al. 2013). SLR planning can include decisions on mitigating the effects of extreme weather events (Smith et al. 2017), adapting to more frequent nuisance flooding, and preparing for managed retreat from coastal zones. Many different actors and groups have vested interests in various aspects of coastal planning, some of which may conflict (Smith et al. 2017). This social and ecological complexity, coupled with scientific uncertainty about the rate and final magnitude of SLR, can make planning difficult. For example, in a content analysis of United States community-level climate change plans that included SLR adaptation plans, Woodruff and Stults (2016) found that few plans substantively addressed uncertainty or post-implementation monitoring, and several had weaknesses when "translating" facts to actionable projects.

One important aspect of planning for SLR involves the identification of challenges or barriers to action (Moser and Ekstrom 2010; Leichenko et al. 2015). Barriers may be ecological, political, legal, economic, technological, or value based; involve interdependent combinations of pragmatic, emotional, and ideological factors; or arise from uncertainty or a lack of understanding of complex socio-ecological systems (Eisenack et al. 2014). For example, some barriers are culturally contingent, in that the deep-seated norms or values of a community may make taking certain actions either more difficult or easier (Adger et al. 2009). Specific barriers to SLR planning that have been identified in the literature include a lack of large-scale (e.g., federal) coordination, insufficient or irregular funding, and a lack of time or staffing to dedicate to planning (e.g., Moser and Luers 2008; Moser 2013; Thorne et al. 2017), as well as a complex legal context (Fletcher and Pike 2007). Planners may also meet opposition from coastal homeowners and political activists, among other interest groups (Moser 2013).

Overcoming barriers to planning can be facilitated by various actions and entities. For example, collaborative networks can help stakeholders build capacity, leverage local knowledge, and strengthen political support for adaptation planning (Lonsdale et al. 2017). Formal boundary organizations, which mediate among various stakeholder and scientist groups, can disseminate information and facilitate the co-production of meaningful knowledge (Cash et al. 2003; Tribbia and Moser 2008). One key need for SLR planning is obtaining information, which planners may require in specific formats and types, and from trusted sources (Lindeman et al. 2015; Tribbia and Moser 2008). Information that is considered credible and high quality may help convince communities to take stronger adaptive actions by reducing uncertainty (Butler et al. 2016). Decision-support tools can also support planning by providing information as well as assisting planners in examining their assumptions (DeLorme et al. 2018b; Stephens et al. 2015, 2017), though the assumptions of such tools and channels of communication must be made transparent for stakeholders to accept their validity (Addison et al. 2013). In order to understand stakeholders' specific information and decision-support needs and build trust, it is beneficial to generate and maintain long-term sustained interaction among scientists and stakeholders (Bremer and Glavovic 2013; Lemos et al. 2012). Finally, activities that heighten awareness of climate change in the general public and particularly political actors are important for implementation planning activities (Romagosa and Pons 2017).

This paper focuses on coastal planners and other stakeholders in the Northern Gulf of Mexico who are engaged in SLR planning or adaptation, (e.g., through resource management, public implementation, or communication and facilitation of collaborative networks). It discusses how they perceive their experiences with SLR planning, including the actions they are taking and the barriers to further action they have encountered, and summarizes their recommendations for addressing barriers that could be applied and extended to adaption planning in a number of settings. This study allows cross-regional comparisons with research on stakeholders in different regions of the United States and in other countries. For example, Californian coastal resource managers perceived funding, staffing concerns, lack of a legal mandate, and a low sense of urgency to be factors that limited SLR planning (Moser and Tribbia 2006/2007). In another regional investigation, estuarine managers along the US Pacific coast identified barriers to planning that included material and staff resources and salient and location-specific information (Thorne et al. 2017). In addition to site-specific information, planners may also lack particular information management systems (e.g., databases) and other tools to support their analytic capacity (Moser and Luers 2008). More broadly, cross-European research shows the importance of understanding cultural values and working directly with affected communities when planning for coastal flooding (Vanderlinden et al. 2017).

Methods

Stakeholder engagement in the EESLR-NGOM project was facilitated by six annual focus groups; all procedures were approved by the authors' Institutional Review Board prior to the study. Focus group interviewing captures qualitative social science data in the form of frank remarks, spontaneous comments, diverse perspectives, and firsthand descriptions via participant interactions (Krueger and Casey 2000; Stewart and Shamdasani 2015). The method is used to understand how various groups situate issues within their own conceptualizations (Hanson-Easey et al. 2015), including understandings of SLR and other coastal issues (Moser 2013; DeLorme et al. 2016, 2018a). Its value lies in part in minimizing researcher biases as participants can respond in their own words (Eisenhauer and Nicholson 2005), offering potential for unexpected insights to emerge (Newig et al. 2008), and providing researchers with opportunities to observe group understanding or consensus about a topic (Newig et al. 2008).

Six focus groups of between 8 and 13 participants each were conducted at annual project workshops from 2011 to 2016. The purpose of the workshops was to reiterate the project's goals and objectives, share updates on the project's different components, and show project improvements stemming from the stakeholders' prior feedback. Workshop participants included project scientists, members of a stakeholder advisory board comprised of natural resource managers and environmental education and communication specialists, and other community stakeholders. The workshop venue rotated among three National Estuarine Research Reserve (NERR) facilities (Apalachicola, Grand Bay, and Weeks Bay NERRs).

At each workshop, a subset of the attendees (advisory board members and other community stakeholders) gathered privately to take part in the focus group. The focus group composition varied slightly each year, with 15 participants contributing to two or more groups over the project duration. All focus groups were moderated by either an EESLR-NGOM project team social scientist who is experienced in qualitative methodology or a science communication expert who was trained specifically to perform this role. Each group started with an introductory statement that specifically urged the sharing of a variety of perspectives, an explanation of objectives, and instructions. The moderator then asked a series of open-ended questions using an interview guide. Participants were encouraged to interact, while the moderator listened actively; maintained a nonjudgmental positive rapport; and asked probing questions occasionally for clarification, for more detail in certain responses, or to elicit differing perspectives on a topic. The groups were audio recorded with permission; had a research assistant managing logistics, taking notes, and monitoring time; and lasted approximately 90 min each. The interview guide was comprised of open-ended questions on topics including SLR adaptation planning actions, stakeholders' operational and informational needs, feedback on the EESLR-NGOM computer model and scientific tools, and outreach suggestions. The guide was pretested with two focus groups consisting of convenience samples and the content remained relatively consistent throughout the project.

The science communicator and social scientist transcribed all audio recordings in their entirety and double-checked them for accuracy. The total dataset included 158 transcript pages plus 33 pages of notes. Data analysis involved an interpretive approach and was performed systematically within and across the focus groups (i.e., annually and cumulatively). This process consisted of listening to the audio recordings and reading all transcripts and notes closely; coding certain words, phrases, and sentences based on the interpreted relevance of the data and developing categories; and making comparisons within and between the coded data to identify relationships, subcategories, and themes (Berg and Lune 2012; Strauss and Corbin 1998). The social scientist conducted the primary analysis and provided preliminary findings to the science communicator. After the science communicator reviewed the preliminary findings, the two analysts discussed themes and interpretations until agreement was reached. The next section summarizes the results, which are supported by illustrative participant verbatim quotations.

Results

Overall, the study's findings provide insight into stakeholders' current SLR adaptation planning activities, their perceived challenges associated with SLR adaptation planning at the local scale, and their recommended strategies for addressing barriers to planning activities. A variety of stakeholder perspectives was represented, but there was also much consensus in viewpoints.

Stakeholders' Current SLR Adaptation Planning Activities

The coastal stakeholder focus groups were concerned about SLR and considered adaptation planning to be crucial and feasible, despite perceived challenges. A sense of efficacy that steps could be taken to prepare for SLR impacts effectively was present in the focus groups. Most participants, however, indicated that adaptation planning was at an early stage, e.g., "We have begun to think about sea level rise a great deal more than we have in the past". Participants were aware of various ecological and social SLR adaptation

initiatives and projects throughout the region and in their local communities but felt that much more should and could be accomplished with tangible projects.

Through their shared examples and experiences, the participants also indicated their own current involvement in a number of these efforts as part of their professional job responsibilities. We broadly categorized these efforts as either more research oriented or more application oriented based on participants' descriptions of the purposes of each project, though we note that several projects included both research and application (Table 1). Research-oriented efforts included performing scientific investigations and

Table 1 Examples of SLR adaptation initiatives and projects in which participants were currently involved, with representative participant quotations

Type of initiative or project	Initiative/project focus	Representative quotation(s)
Research oriented	Performing SLR-related scientific studies and data monitoring	"We've been doing a number of characterizations looking at the sea floor change". "We're collecting baseline data especially focused on some imperiled amphibian species that are in…coastal wetlands". "We're working with our land use planners to identify the ownership of where we think sea level rise will be…all along the coast, for our whole district".
	Developing and testing SLR-related models and tools	"Developing different predictive tools that…predict how it will impact certain habitats that we're interested in and testing those out". "We've partnered with…others on doing some modeling".
	Conducting vulnerability assessments and ecosystems services studies	"One particular project…is focused on the loss of ecosystem services with SLR and we try to inform managers…on the results". "Working on a vulnerability assessment to evaluate…how vulnerable ecosystems are to SLR….To inform adaptive management strategies".
Application oriented	Implementing coastal protection and restoration projects	"Habitat shoreline protection". "Barrier island restoration, wetland creation, wetland restoration, terracing". "I've been working to develop our beneficial uses of dredge materials program…the primary focus of which is marsh restoration".
	Incorporating SLR information and scenarios into project design guidelines and local habitat restoration and hazard mitigation plans	"The agency that I work for…has actually formally developed guidelines…to incorporate sea level rise into design of all of our projects". "Our stewardship coordinator is writing a…comprehensive restoration plan…and he is definitely incorporating SLR modeling". "I've worked with several local communities that are incorporating sea level rise scenarios into their hazard mitigation plans".
	Funding research and community projects that address certain ecological and social dimensions of SLR adaptation planning	"We've had a request for proposals for state wildlife grants…a project that combines community-based oyster shell recycling for an oyster reef living shoreline". "We've funded comprehensive plans that address…hazards for resilient communities". "My office has been overseeing grants…to the local planning of the city". "Putting together an adaptation guide…projections of different climate change effects and how…they might impact different species and habitats across the state".
	Passing laws and regulations	"Transfer of development rights programs". "Directly implementing some of our responses to sea level rise in the form of passing laws and putting a program into place that helps us better manage sediments in littoral zone".
	Conducting training workshops and community outreach programs	"We've done several workshops…on the value of green infrastructure by adding conservation lands". "We hosted a workshop on the legal implications for local governments of SLR". "Training…[extension] agents. Helping them understand SLR and its effect on coastal ecosystems…so that they can take information to the public". "We've taken the SLR visualization tool into the mall and…shown people where they are and how that might affect them".

monitoring, developing and testing SLR-related models and tools, and conducting vulnerability assessments and ecosystem services studies. Application-oriented projects included implementing coastal protection and restoration projects, incorporating SLR information and scenarios into project designs and planning, funding projects that address ecological and social dimensions of SLR adaptation planning, encouraging local government to adopt and enact legislation, and conducting community workshops and training. Overall, while participants described challenges associated with planning and adaptation, they seemed optimistic about existing and ongoing SLR planning initiatives they discussed and committed to a long-term process.

Perceived Challenges for SLR Planning

While participants were able to indicate several different types of planning efforts, they also perceived that local adaptation planning for SLR impacts was hindered by many complex and interrelated challenges. Six major types of barriers associated with planning and decision-making emerged from analysis. These barriers, which are not mutually exclusive, include: (1) inadequate funding, (2) lack of political and public support, (3) conflicting ecological and social priorities, (4) managing risk and uncertainty, (5) increasing coastal property ownership, and (6) coordinating cohesive adaptive planning. Each challenge is described below, along with representative participant quotations.

Inadequate funding

A first identified barrier to local SLR planning is inadequate funding from government agencies and other sources to design and implement SLR adaptation projects effectively. While in some cases a general lack of funds for adaptation planning activities was described, in others the participants perceived inconsistent funding as a challenge. One participant remarked, "we have a very large land acquisition program but…the funding for it is always sporadic and… changes with the political whim so…we've got a large area approved for acquisition but the money is not available to do that". Once funding was acquired, some participants described an unclear decision-making process for allocating funds, suggesting that competing interests among programs or that planning activities were not prioritized to take advantage of inconsistent funds.

Lack of political and public support

A second, related, barrier and one that received substantial discussion in the focus groups is a lack of political and public support for SLR planning from some local governments and agencies. For example, SLR is not explicitly considered in many municipal comprehensive plans or building codes, or within the operational directives of specific agencies tasked with infrastructure maintenance and planning. Moreover, the process of obtaining support for addressing SLR among elected officials and policy-makers was described as slow and arduous (e.g., "We've got to chip away. This ain't going to happen quick"). Some participants also mentioned bureaucratic barriers to implementing SLR adaptation stemming from obstacles to official approval for incorporating SLR research information and tools into existing project designs, materials, and management operations. For example, one participant mentioned the need to cite local codes in order to convince their agency supervisors to incorporate adaptation planning into operations ("Your higher-ups have to be the ones to agree to it… they ask me all the time, 'What gives you the right to do this?' I have to quote an ordinance").

Five subcategories of barriers associated with gaining political and public support for SLR adaptation were identified from the focus group discussions (Table 2). Several participants experienced persistent climate change skepticism, apathy, or simply resistance to considering long timescales for planning within particular communities. Participants indicated that their professional roles necessitated persuading others to accept scientific evidence before supporting adaptation planning (e.g., "Part of the issue is how do we get the public, the potential stakeholders to appreciate what this is, what the situation is, and accept it"). One specific barrier for communication was the challenge of communicating about the scientific uncertainty associated with SLR risk. While participants recognized the need to connect with multiple audiences, achieving buy-in from key types of stakeholders was considered imperative in fostering funding and favorable policies with respect to SLR planning. However, achieving buy-in was viewed as a laborious process requiring perseverance and not necessarily completely attainable.

Conflicting ecological and social priorities

Natural resource management and infrastructure development and maintenance involves navigating ecological-social interdependencies. Determining priorities among these dynamic interdependencies was identified as a third barrier for SLR adaptation planning. A core theme in the discussions was difficulties in decision-making and determining priorities due to the interconnection of the natural and built environments, including the societal, economic, and political context of human communities, for example, "They're intrinsically linked. You're looking at making development planning decisions that will affect natural areas, vice-versa".

Table 2 Perceived barriers related to gaining political and public support, with representative quotations

Subcategory of barrier	Representative quotation(s)
Climate change skepticism	"We live in a place where…the preponderance…of people—it's not that they're not aware of climate change. They absolutely reject it's happening and so we have a big job in terms of convincing policy makers and public officials to pull their heads out of the sand and see what's going on". "I've been in discussions with people that make policy and whenever I mention climate change, the discussions stops and they, you know, try to correct my thinking". "…a lot of the public tends to gravitate towards the naysayer…Look at the official numbers from the climate scientists that contribute global warming to human activity and yet we have these lone voices and there's a lot, a lot of pull and gravitation towards those, you know, lone wolf dissenters".
Ignorance and apathy	"Believing it actually exists. It's a major hurdle…You just have to be careful in how you…approach certain people about any topics related to climate change or sea level rise". "In a meeting…an older guy that had retired recently…said that he didn't have to worry about sea level rise because he wasn't going to live long enough to see it".
Short-term thinking	"I've been involved with a living shoreline initiative and tried to introduce…the idea of sea level rise… The people who want the projects have immediate erosion issues they want to address so they're not thinking long-term". "…without some urging and financial assistance in most of the local communities it may not happen because, you know, the turnover of local politics…they're looking at four-year terms and then they move on so they're not going to look at the long-term ramifications of this without some assistance".
Engagement of diverse stakeholders	"We've got to find a way to reach the general public but also the elected officials, the transportation officials, the…infrastructure-type people to get this on their radar screens".
Communicating risk and uncertainty	"How to reach out to them…in a way that they can assimilate and appreciate the information and the science…and where it's taking it into the future without scaring the heck out of them". "We need another word for 'uncertainty'. …Everybody hears that and goes, 'Oh, they're not sure about this'". "…when you start talking to the public, you start trying to explain to them significant difference and, 'We did this ANOVA, and we came up with this margin of error.' They're gone…there's people out there [that] no matter what, if you say there's an error in the analysis, they're going to say, 'Oh, it's not correct'".

One particular topic of discussion was potential future conflicts between movement of coastal marshes and human residents due to SLR, e.g., "There's an interrelationship… We're concerned a lot with marsh…and how it's going to survive, and move, or migrate, and the same thing is going to be happening at the human community level".

Different communities and stakeholders were viewed as having different priorities with respect to preparing for SLR, many of which may be centered on the built environment and human community rather than the local ecology. Several participants suggested that local residents would need to be better informed about the economic value of the natural environment before including ecological effects in planning, e.g., "I'm not convinced that there's political will to preserve natural habitats unless we can document the value of those habitats". This was considered a challenging task, "People can grasp the costs of a wastewater treatment facility or a water intake. I'm not sure that there's a similar understanding of the value of a thousand acre salt marsh or five hundred acres of SAVs" (submerged aquatic vegetation).

Managing risk and uncertainty

A fourth barrier that received attention in the focus groups involved managing risk and uncertainty in decision-making, in terms of acceptance, use, and ultimate adoption of any innovative new SLR planning models or tools and the future scenarios to which the models or tools are applied. One concern was decision makers' possible perception of risk associated with employing new tools, e.g., "It goes back to risk. Are you going to take a risk that there's something that's new, that looks good, but may not have been proven, or are you going to go with something…that's well established and that's been used. It may not be perfect, but it works". Other concerns centered on low tolerance of uncertainty particularly for decisions that could affect the local economy, and recognition that uncertainty about the magnitude of future SLR made planning for adaptation more challenging, e.g., "You're saying, 'Okay, the water's going to rise somewhere between four inches and six feet… You have to adjust this project based on the fact that it might not rise much or it might be in your living room'. And I'm not totally sure how to do that".

Increasing coastal property ownership

The increasing numbers of landowners living in vulnerable coastal areas was a fifth perceived barrier associated with adaptive planning for SLR impacts. Participants acknowledged strong challenges in managing a mix of public and

private land at a landscape scale, e.g., "There's always going to be that interface…between what's publicly held and what's privately held. What's going to be the expectations of private property owners versus what's going to be the expectations of what we do on conserved land". Other concerns included property owners' strong feelings about the importance of maintaining ownership of their property and, relatedly, the perception that government cannot purchase all privately held coastal property in order to reduce this barrier.

Coordinating SLR adaptation planning

Participants thought that current actions to prepare for SLR by various coastal communities and organizations would benefit from a concerted coordinated effort but that doing so would be difficult. This sixth barrier, coordination of SLR adaptation planning, was thought to stem in part from broad geographic parameters as well as from the diversity of involved entities with different agendas. Different specific challenges and perceptions about SLR planning were discussed among communities within each state, at different levels of political organization (e.g., between county commissions, state legislatures, and national Congressional representation), and among different regions of the United States. One particular challenge discussed was the differing time frames that agencies consider when planning, e.g., "There's a big disconnect between our emergency managers planning for a short time period, like a five-year plan, and our community planners…planning for these longer planning horizons…We even have some regional planning that includes sea level rise…but none of those planning efforts are necessarily connected, not only the people and the time frames but also at the local versus regional versus State…levels".

Recommended Strategies for SLR Adaptation Planning

Lastly, participants offered various recommended strategies to address barriers to adaptation planning, beyond the planning activities that they were then currently implementing. These can be grouped into four major categories: (1) harnessing solid community leadership with the resources and willingness to take responsibility for SLR impact planning initiatives, (2) conducting more rigorous scientific research on SLR impacts, (3) improving land-use planning, and (4) implementing effective outreach to the general public. Representative quotations are presented in Table 3.

Based on their experiences, focus group participants articulated the importance of public outreach in particular as a key strategy for overcoming challenges. In general, participants believed a more informed public that was supportive of SLR adaptation could influence political leaders to take actions through their votes. Thus, two goals for public outreach were articulated, one educational and one persuasion oriented. It was also recommended that SLR adaptation planning aim to align with the values and concerns of other coastal community stakeholders, another

Table 3 Examples of recommended strategies to overcome barriers to SLR planning, with representative participant quotations

Recommended strategy	Representative quotation(s)
Harnessing community leadership	"It's the planners…that can initiate that responsibility for seeing that sea level rise…is taken into account for whatever is planned… It's got to be taken into account at the planning level". "It would be nice if government would lead…My observation has been it tends to be some of the business entities that are actually a little bit more forward thinking on that because they see it as an economic incentive". "They have a lot of…money at risk right now and I think many of those companies have realized that and are planning".
Conducting more rigorous scientific research on SLR impacts	"The best available science to make decisions". "The impacts of sea level rise…we need to know more precisely if we're to help guide and provide information to the public and other decision makers". "Getting more precise data to the local governments…Once that becomes…believable information, that's when they'll act".
Improving land-use planning	"Strategic placement of infrastructure". "Direct growth away from vulnerable areas". "Land acquisition to prepare for habitat migration". "Green space". "Restoration of coastal wetlands". "We have to start considering…sea level rise in watershed management plans".
Implementing outreach to the general public	"Informing the public more and making them…better understand because…if they're behind whatever management we need to do, then it's more likely to be done". "Some of the…policy makers…It's their constituents and what they want".

persuasion-oriented goal, e.g., "connect with the people who are making those decisions…pique their interest in… wanting the information".

Discussion

The results of this study provide a regional perspective on the challenges that coastal stakeholders face when planning for the global phenomenon of SLR, but also highlight the actions that professionals are currently taking to address planning challenges as well as their suggestions for further efforts. Over the 6-year course of the study, participants remained optimistic that at least some barriers could be overcome and that certain adaptation strategies were feasible. They also seemed resolved to continue to search for solutions and remain persistent in their pursuits of successful adaptation strategies.

Broadly, participants considered some barriers more difficult to address than others. For example, lack of political support for SLR planning may have been viewed as both a large and widespread challenge, as evidenced by the frequency with which this issue was raised. Moreover, some participants seemed to consider public attitudes for SLR planning to be especially challenging. Lack of both political and public support for action seemed to be regarded as more difficult to overcome in situations where climate change skepticism or denialism was involved. By contrast, related issues such as low prioritization, resistance from certain officials, short-term thinking, public apathy, and engagement of a diverse spectrum of stakeholders seemed to be regarded as barriers that could be overcome with improved outreach or strategic thinking.

Another SLR planning-related barrier was the need to weigh the priorities of different stakeholder groups regarding economic development of the coast and the needs of ecological communities. For example, several participants mentioned concern for conflicts between human land use and potential landward migration of salt marshes, which will be necessary for their survival. This was of particular concern when discussing the desires of coastal property owners. Balancing the priorities of different groups is a crucial part of coastal zone management (Bremer and Glavovic 2013) and more broadly pertains to sustainable development (Cash et al. 2003). Balancing the needs of different groups may be complicated by a lack of current knowledge about specific SLR adaptation or protection measures. For example, property owners may favor "hardened" shoreline protective measures (e.g., seawalls and bulkheads) over "nature-based" features (e.g., artificial reefs and constructed marshes), though the latter may, in some cases, be more resilient to storms (Smith et al. 2017). Thus, there is a need for public education, provision of most recent research results, and articulating a common vision at the community level for what successful adaptation would entail (Moser 2013). In addition, those facilitating a participatory planning process should identify and address barriers to participation that may disproportionally affect marginalized populations (Rockloff and Lockie 2006).

Some strategies mentioned for addressing barriers were procedural, such as improving land-use planning and conducting additional research on SLR impacts. One complicating factor was management of uncertainty, particularly uncertainty in scientific modeling to support SLR response recommendations. While some concerns related to communication of uncertainty can be addressed via improved communication and trust building among scientists and stakeholders (Addison et al. 2013; Bremer and Glavovic 2013), some participants in this study suggested that any discussion of uncertainty in a public setting can lead to an erosion of trust in scientific models. A second complicating factor was the need to coordinate adaptation planning among organizations and political entities at several different scales, such as industry, community resident associations, and different levels of government. Together, these factors support the need to address scientific uncertainty in a nuanced way, depending on the specific audience in any particular communication setting.

Participants' current involvement in SLR adaptation planning activities reflected these strategies. For example, participants mentioned several studies aimed at improving underlying natural science understanding, such as ecosystem monitoring, developing predictive computer models, and conducting site-specific vulnerability assessments. Other projects reflected application, such as changing planning guidelines, coastal restoration, funding community-based projects, and conducting community outreach. Some of the greater perceived challenges, such as political or ideological opposition, obtaining long-term funding, large-scale coordination, and explicitly addressing conflicts between competing ecological values (e.g., marsh migration and property ownership), seemed not to be addressed directly in current activities. These latter more culturally dependent or value-based barriers may in fact represent limits to action, as suggested in other reports (Adger et al. 2009; Moser and Ekstrom 2010).

Comparisons with Planning Concerns in Other Regions

In some cases, our results mirror those of previous research in other geographic locations, while in others they extend findings from previous studies, similarly to other studies of regional differences (Lonsdale et al. 2017). As in this study, previous research has found that barriers to climate change adaptation among coastal managers included time

constraints, finances, and staffing (Thorne et al. 2017), the need to prioritize more immediate management concerns (Moser and Tribbia 2006/2007), lack of data and analytic tools to assist with decision-making (Moser and Luers 2008), and issues of scale and jurisdiction (Moser and Ekstrom 2010). However, in this study we were able to better identify underlying specific social and political drivers that were important in the local context, such as community ideology and worldview, the complexity of coordinating among organizations at multiple scales, and balancing ecological and human-centered interests. We suggest that international practitioners and researchers in particular should consider how the importance of these and other drivers might vary in their particular contexts or across regional borders.

In particular, participants seemed to view barriers that interacted with the social factors of ideology (specifically regarding climate change), demography, desired long-term lifestyle, and community norms to be more challenging than those related to scientific knowledge, uncertainty about risks and responses, information sharing, and organizational coordination. Residents of the Northern Gulf region are somewhat less likely than the US average to believe that global warming is occurring, that it is human caused, and that it will harm people (Howe et al. 2015). Public perceptions of climate change in the region have been shown to be largely driven by political ideology rather than long-term change in local weather conditions (Shao and Goidel 2016), though experience of natural disasters and higher socioeconomic vulnerability can counteract these trends (Cutler 2016). Such large-scale factors are likely to be beyond the ability of community planners and managers to overcome directly (Moser and Luers 2008). As Eisenack et al. (2014) discuss, many barriers to adaptation are interdependent and actor- and time-sensitive. For example, place attachment, identity, and values are central to community acceptance of adaptation actions in the USA (Moser 2013) as well as in Spain, Italy, and France (Vanderlinden et al. 2017). While the present study did not specifically focus on the concerns and ideas about adaptation planning held by the general public, it is clear from the response of project participants that these issues are central to the success of SLR planning.

Many of the suggested strategies for overcoming barriers hinged on outreach, education, interaction with members of the community, and coordinating planning efforts among municipalities and organizations. Also reflected in the participants' comments was the perception that many elected officials were unwilling to take action without pressure from their constituents, which Butler et al. (2016) have characterized as a "low-regrets incrementalism" approach to SLR planning. Romagosa and Pons (2017) have similarly found the importance of public and political awareness of climate change for strengthening support for SLR planning and adaptation in Italy. Governance norms vary among regions and countries, and we suggest that practitioners should familiarize themselves with both local political norms and historical "top-down" decision-making, both of which may affect local communities' expectation and trust in the decision-making process (Vanderlinden et al. 2017; Saleem Kahn et al. 2020).

The importance of social interaction, information sharing, and outreach has been identified in other studies on coastal planning and adaptation (Cvitanovic et al. 2015). For example, McGreavy et al. (2018) point to the importance of periodically assessing stakeholders' information needs and sharing that information in inclusive community forums. Kochnower et al. (2015) articulated the importance of local "champions" who would promote and spearhead the adoption of particular adaption strategies, as well as the importance of social networks and shared community norms for promoting innovation. Similarly, Tribbia and Moser (2008) point to the importance of boundary organizations that may serve as information clearinghouses for planners and other stakeholders. For example, the establishment of the Northern Gulf of Mexico Sentinel Site Cooperative (https://oceanservice.noaa.gov/sentinelsites/gomex.html), which brings together academics; consultants; local, state, and federal agencies; and NGOs occurred, in part, as a result of the EESLR-NGOM project. Developing boundary organizations with an international focus might be valuable to practitioners working in coastal regions that cross national borders.

Study Limitations and Directions for Future Research

We conclude by acknowledging limitations of this study and suggesting directions for future research. First, the participants in the EESLR-NGOM project were comprised of a selected subset of all potential stakeholders in the study region. Project participants were professional coastal and community planners and environmental communicators. Therefore, the perspectives of other stakeholders, such as public health professionals, social justice advocates, industry representatives, and the general public were not explicitly represented. Future research that centers on members of these groups would enrich our understanding of SLR planning concerns. More broadly, we recognize limitations of qualitative focus group research in terms of its small number of nonrandom participants, which affects generalizability of results. Nevertheless, this project does capture the concerns and SLR planning efforts of this subset of professionals and allows in-depth examination of both immediate barriers and underlying social and political influences.

Second, we suggest the following areas for future research. First, the project participants described several immediate actions and longer-term strategies for overcoming barriers to SLR adaptation. Several of the actions and strategies that they described relate to actively identifying helpful information sources or exchanging information with other professionals who are facing similar challenges. Therefore, making personal connections among individuals as well as institutional links between organizations—such as via boundary organizations—may be a key strategy for overcoming barriers. A second set of research needs articulated by the participants focuses on understanding the physical responses of coastal ecosystems to SLR, including better characterization of the uncertainty of SLR projections and ecological effects and better understanding of how specific types of coastal adaptation (e.g., nature-based protective measures) will perform.

Two final key areas of future research center on engaging the public in SLR planning in ways that address the interdependent nature of barriers that have been identified. We suggest that this research might be particularly helpful in international or intercultural settings, due to the interplay between barriers and cultural values, as discussed by Saleem Khan et al. (2020). First, future public engagement research should focus on understanding how planners can engage the public in SLR visioning or planning in a way that is sensitive to place-based cultural norms and potential ideological or worldview issues like climate change skepticism or denialism. In some cases, this may involve helping to connect local stakeholders to the existing literature on climate change communication research, while in other cases it may involve situated local research that aims to understand these issues at the community level. Making social science-focused research more accessible to community planners and resource managers may help them lower some of the current barriers to SLR planning that they perceive as the greatest. Second, many participant responses indicated that it will be critical to engage community members in the SLR planning process, both to help create a shared vision of what adaptation should look like and to motivate elected officials to take action. Thus, social science research that centers on the concerns and desires of coastal community members for SLR planning in the context of future community visioning should be conducted. By advancing these two key areas we can further overcome perceived barriers and formulate strategies to address our shared future challenges.

Acknowledgements This work was supported by the National Oceanic and Atmospheric Administration's Ecological Effects of Sea Level Rise Program (awards NA10NOS4780146 and NA16NOS4780208) and the Louisiana Sea Grant Laborde Chair. The statements and conclusions are those of the authors and do not necessarily reflect the views of NOAA. We wish to thank management and staff of the National Estuarine Research Reserves of Apalachicola, Grand Bay, and Weeks Bay as well as the National Oceanic and Atmospheric Administration's Office of Coastal Management.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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