AN ASBPA WHITE PAPER:

National coastal management challenges and needs

By

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ABSTRACT

In partnership with the U.S. Geological Survey Coastal and Marine Hazards and Resources Program (USGS CMHRP) and the U.S. Coastal Research Program (USCRP), the American Shore and Beach Preservation Association (ASBPA) has identified coastal stakeholders' top coastal management challenges. Informed by two annual surveys, a multiple-choice online poll was conducted in 2019 to evaluate stakeholders' most pressing problems and needs, including those they felt most ill-equipped to deal with in their day-to-day duties and which tools they most need to address these challenges. The survey also explored where users find technical information and what is missing. From these results, USGS CMHRP, USCRP, ASBPA, and other partners aim to identify research needs that will inform appropriate investments in useful science, tools, and resources to address today's most pressing coastal challenges.

The 15-question survey yielded 134 complete responses with an 80% completion rate from coastal stakeholders such as local community representatives and their industry consultants, state and federal agency representatives, and academics. Respondents from the East, Gulf, West, and Great Lakes coasts, as well as Alaska and Hawaii, were represented. Overall, the prioritized coastal management challenges identified by the survey were:

- Deteriorating ecosystems leading to reduced (environmental, recreational, economic, storm buffer) functionality,
- Increasing storminess due to climate change (i.e. more frequent and intense impacts),
- Coastal flooding, both
  - Sea level rise and associated flooding (e.g. nuisance flooding, king tides), and
  - Combined effects of rainfall and surge on urban flooding (i.e. episodic, short-term),
- Chronic beach erosion (i.e. high/increasing long-term erosion rates), and
- Coastal water quality, including harmful algal blooms (e.g. red tide, sargassum).

A careful, systematic, and interdisciplinary approach should direct efforts to identify specific research needed to tackle these challenges.

A notable shift in priorities from erosion to water-related challenges was recorded from respondents with organizations initially formed for beachfront management. In addition, affiliation-specific and regional responses varied, such as Floridians concern more with harmful algal blooms than any other human and ecosystem health related challenge.

The most common need for additional coastal management tools and strategies related to adaptive coastal management to maintain community resilience and continuous storm barriers (dunes, structures), as the top long-term and extreme event needs, respectively. In response to questions about missing information that agencies can provide, respondents frequently mentioned up-to-date data on coastal systems and solutions to challenges as more important than additional tools.

KEYWORDS: stakeholder, increasing storminess, nuisance flooding, sea level rise, beach erosion, water quality, deteriorating ecosystems.

This assessment of coastal management challenges and needs is the first of its kind conducted by the ASBPA and likely the only one at a national scale. The State of California has published three similar, state-scale assessments. The most recent was part of its Fourth Climate Change Assessment (Moser *et al.* 2018). Results of this national assessment will ultimately help identify research needs to guide ASBPA's advocacy for appropriate investments in useful research, tools, and resources to address today's most pressing coastal challenges.

Context & motivation

On a national scale, beachfront and coastal communities' interest in adaptation, climate change risks, extreme event impacts, and water-level changes have risen in prominence over the last decade. ASBPA set forth the following goal in their 2019-2021 Strategic Plan: "*By 2021, the nation's top five coastal engineering and/or management challenges, as determined by ASBPA members, are identified; and the latest science and expert recommendations on each issue are published*." Since inception in 1926, ASBPA has advocated for science-based coastal policy. ASBPA is dedicated to preserving, protecting and enhancing our coasts by merging science and public policy. Including the nation's top coastal management challenges as a goal in the strategic plan will help to guide future science-based policy directions of the association.

As a national nonprofit organization, ASBPA has also been committed to educating managers, policy makers, and the public about the importance of our

nation's shores and beaches. Through this effort, ASBPA, USCRP, USGS CMHRP, and partners aim to educate stakeholders about the top challenges as well as about areas of needed research under each topic area that if addressed may lead to societal benefits. This education will also extend to researchers and funding agencies to help develop user-inspired research projects that address societal needs. In addition, the USCRP is interested in this effort because it helps address program objectives, which include identifying societally-relevant research priorities and translating science to stakeholders (e.g. city managers, coastal resilience officers). The USGS CHMRP provided funding for this work to assess their stakeholders (who are they and how do we reach them?), to identify stakeholders' requirements, and to evaluate where coastal managers find technical information.

METHODS

To identify the nation's top five coastal management challenges and needs as part of the organization's 2019-2021 Strategic Plan, the ASBPA initially queried members interactively during the October 2018 National Coastal Conference in Galveston, Texas. Responses were compiled into a preliminary list of challenges and discussed during a special meeting of the ASBPA Science & Technology Committee in November 2018. A series of subsequent meetings throughout 2019 helped to refine and categorize the list of challenges and needs to create a multiple-choice survey.

The list of coastal management challenges provided by ASBPA members and conference attendees were characterized according to the three broad research themes identified in the Nearshore Report (The Nearshore Processes Community 2015): 1) Long-term coastal evolution due to natural and anthropogenic processes; 2) Extreme events: flooding erosion and subsequent recovery; and 3) Physical, biological, and chemical processes impacting human and ecosystem health. Responses under each of the three topics were further categorized into specific coastal management challenges and needs (tools and strategies that stakeholders need help with). Survey developers intentionally left out non-technical challenges related to funding, permitting delays, and institutional barriers to focus the responses on technical topics that could inform future research.

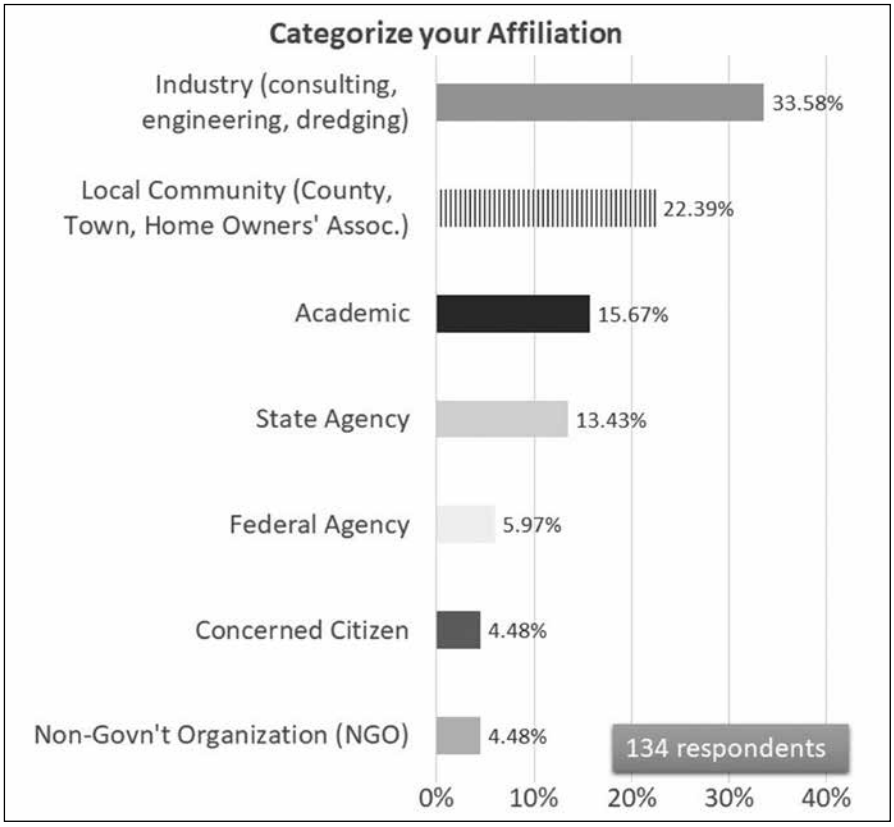


Figure 1. Bar chart of the 134 survey respondents' affiliations.

Figure 2. Word clouds of survey respondents' organization name and job title.

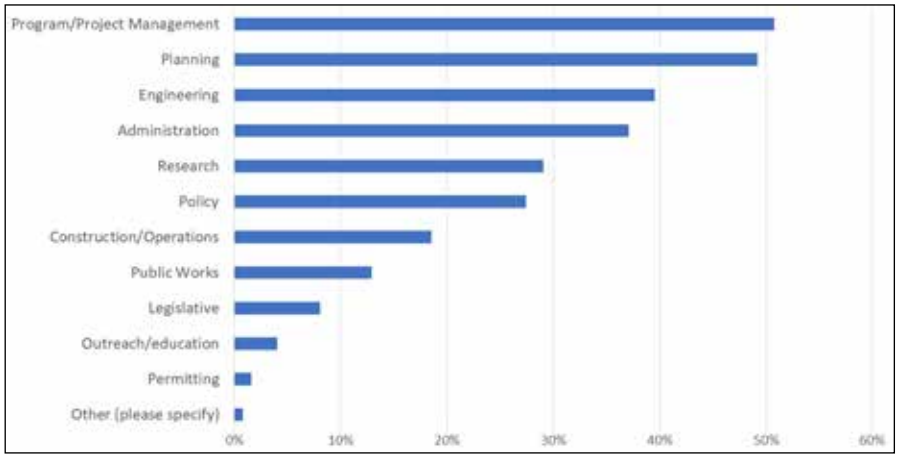


Figure 3. Bar chart of survey respondents' job duties.

The survey provided the following introductory paragraph to respondents: "This survey aims to evaluate stakeholders' most pressing coastal management challenges (problems and needs). Please share what problems you and your organization feel most ill-equipped to deal with in your day-to-day duties and which tools you most need to address these challenges. We'd also like to begin to understand where you go to find technical information and data. The results

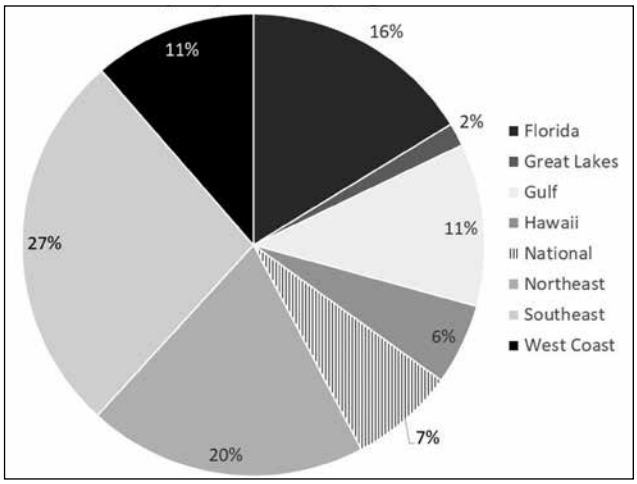


Figure 4. Pie chart of the regional geographic distribution of survey respondents. National indicates respondents working for firms or agencies that are not region-specific.

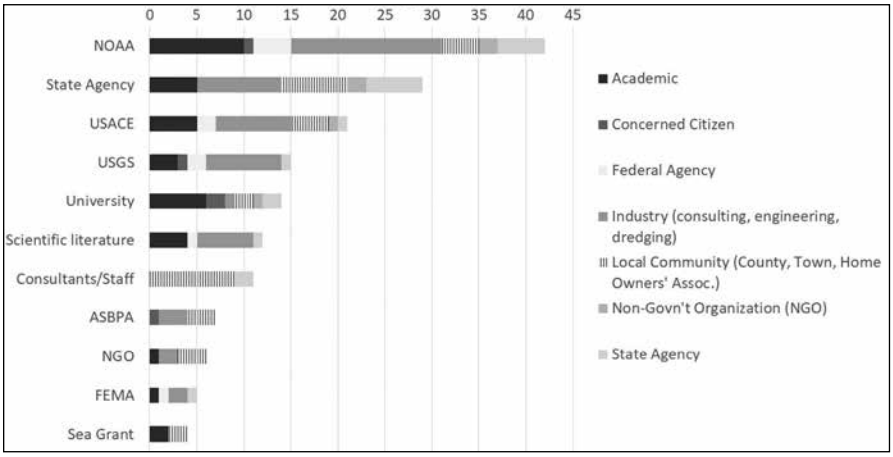


Figure 5. Bar chart of survey respondents' sources of technical information categorized by affiliation.

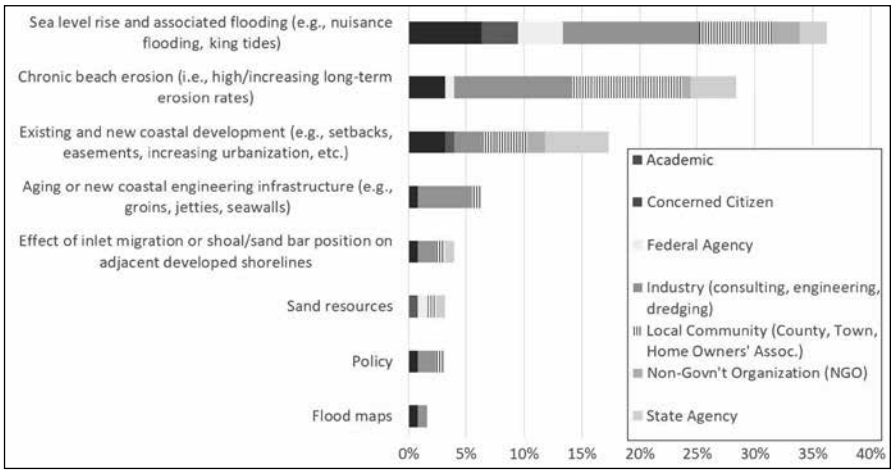


Figure 6. Bar chart of survey respondents' greatest long-term coastal management problems categorized by affiliation.

are critical to help us invest in useful research, tools, and resources to address today's most pressing coastal challenges."

Target audience

The survey targeted coastal professionals such as planners, resource managers, public works engineers, emergency response managers, community administrators, and elected officials, as well as representatives of environmental organizations working on coastal issues, private-sector consultancies, and academics with a focus on coastal research. Respondents were drawn from the local, regional, state, and federal levels.

The survey opened during the ASBPA National Coastal Conference in Myrtle Beach, South Carolina, in October 2019 and closed in April 2020. During that time, the survey was promoted to and taken by members of the ASBPA, ASBPA chapters/sister organizations, USCRP, and Coastal States Organization through email campaigns, social media, and conference presentations. Members of these organizations primarily have a coastal and, more specifically, often beachfront perspective. Traditionally, for example, the ASBPA has focused on beach and shore preservation via beach nourishment and dune restoration. Thus, an inherent bias toward challenges like beach erosion might be expected.

Survey design

The Survey Monkey web tool was used for this 15-question survey. The first section of the survey aimed to understand respondents' demographics, organization and job roles and responsibilities and included questions to categorize the respondents' affiliation, organization name, title, department, and job duties. The next section addressed the coastal management topics that present the greatest problems to respondents' day-to-day work. Questions including phrasing, for example, like to perform job duties for your organization, what is the greatest challenge? Where do you need the most help? Respondents' were specifically asked to focus on management challenges related to physical coastal processes (waves, sediment transport) and to refrain from elaborating on policy or communication challenges. The last section assessed the tools and resources coastal managers felt they needed to address the coastal management challenges, including questions about whether users had the tools and resources they needed, where they find them, and what information is missing.

RESULTS & ANALYSIS

The survey yielded 134 complete responses with an 80% completion rate. The typical respondent took seven minutes to complete the survey. This section characterizes the survey population, discusses management challenges and needed tools and strategies, and the tools and resources that survey respondents need to address their coastal management challenges.

Characterization of the surveyed population

Survey participants were asked to answer several questions to describe their affiliation, job duties and title, and region of the U.S. at the beginning of the survey. These results characterize the

respondent population and conclude that the intended target of coastal managers (stakeholders) was successful.

The majority of responses were from industry and local community representatives, followed by the academic sector (Figure 1). State agency staff also represented 13% of respondents. Respondents' organization name and job titles (Figure 2) are reflective of the target population of coastal professionals from state and local agencies, as well as their industry representatives. Most of the respondents self-identified as program managers, planners, administrators, and engineers (Figure 3). Together these characterizations suggest a group of survey respondents that represent coastal managers and their representatives.

Finally, the geographic location of survey respondents is presented to confirm that results are representative of a national scale survey and, in the next section, to analyze whether coastal management challenges vary across the U.S. The majority of respondents are from the Southeast (Virginia, North/South Carolina, and Georgia), the Northeast, and Florida (Figure 4). The West and Gulf coasts are each represented by 11% of survey respondents. A survey response from Alaska was included in the West Coast region. Six percent of survey respondents are from Hawaii, while 7% had a national perspective as a result of working for a large consulting firm or government agency.

Because the survey intent was to capture the needs of coastal managers, the authors briefly considered analyzing the survey results without academic responses which represented the third-most common respondent (Figure 1). To examine whether or not different affiliations of survey respondents accurately characterized the opinions of U.S. coastal stakeholders, the question of "where do you get your technical information" from the third section of the survey was analyzed (Figure 5). Not surprisingly, as survey respondents' perceived technical capacity increases, their sources of information become more specialized. For example, academics obtain information from scientific literature; whereas, local community representatives often obtain information from consultants or staff. Interestingly, respondents from nearly all affiliations, including local community representatives, noted that they obtain at least some technical information from universities. For this reason, responses from all affiliations, regardless of their perceived level of technical capacity, are included in the survey analysis. The assumption is that all affiliations have some influence over U.S. coastal managers' opinions of challenges and needs. For example, a local university may be advising and working with town managers to address a site-specific challenge. The opinions of the academic therefore will influence the coastal managers' perspective. This report discusses the perspectives of local community and state agency representatives as core "coastal managers."

Overall, the survey populations' affiliations, job duties, region of the U.S., and sources of technical information indicate that survey results represent the opin-

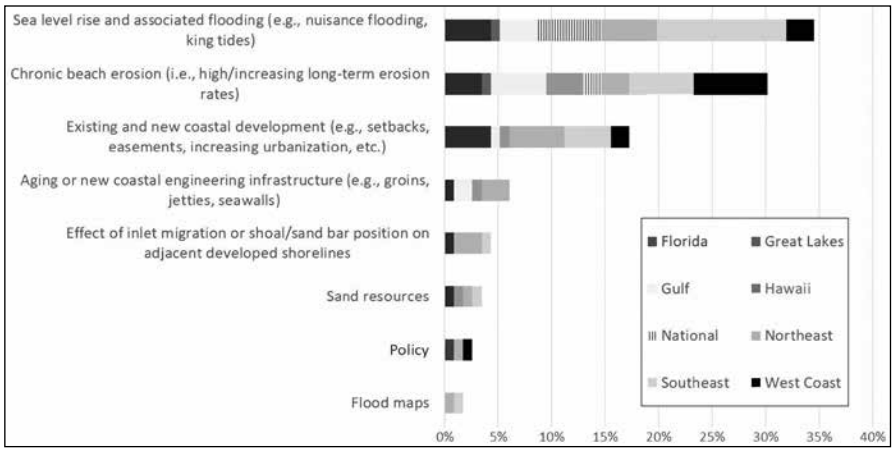


Figure 7. Bar chart of survey respondents' greatest long-term coastal management challenge challenges characterized by region.

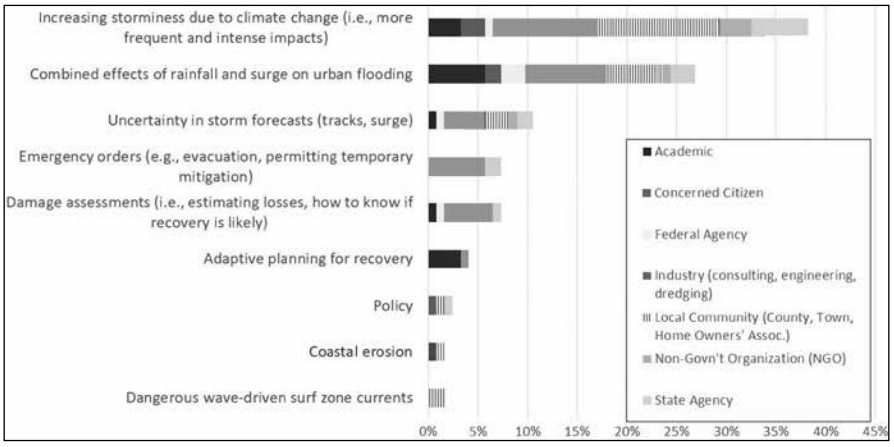


Figure 8. Bar chart of survey respondents' greatest extreme-event related coastal management problems categorized by affiliation.

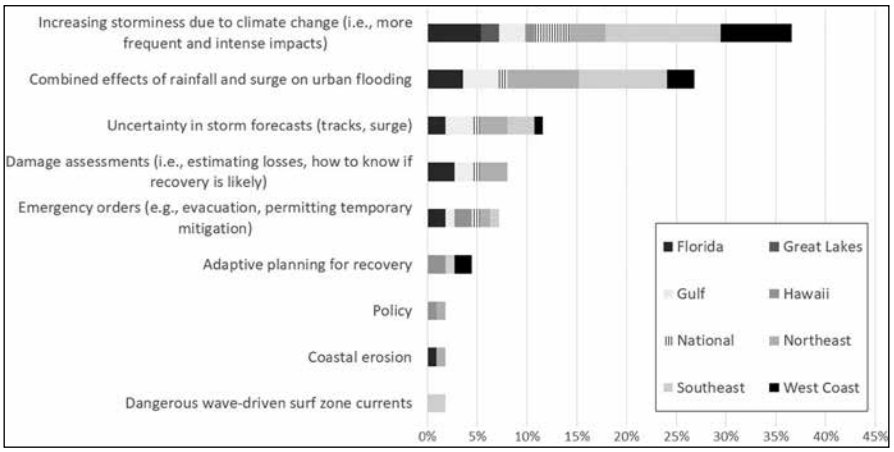


Figure 9. Bar chart of survey respondents' greatest extreme-event related management challenges characterized by region.

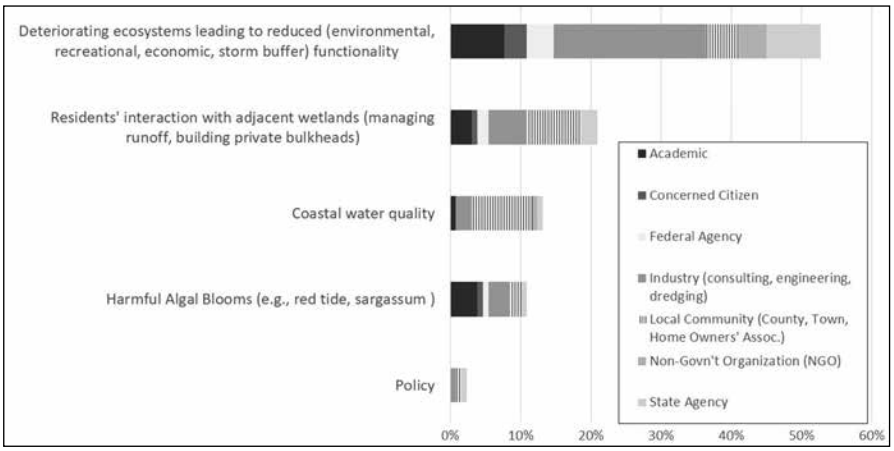


Figure 10. Bar chart of survey respondents' greatest human/ecosystem health management challenges categorized by affiliation.

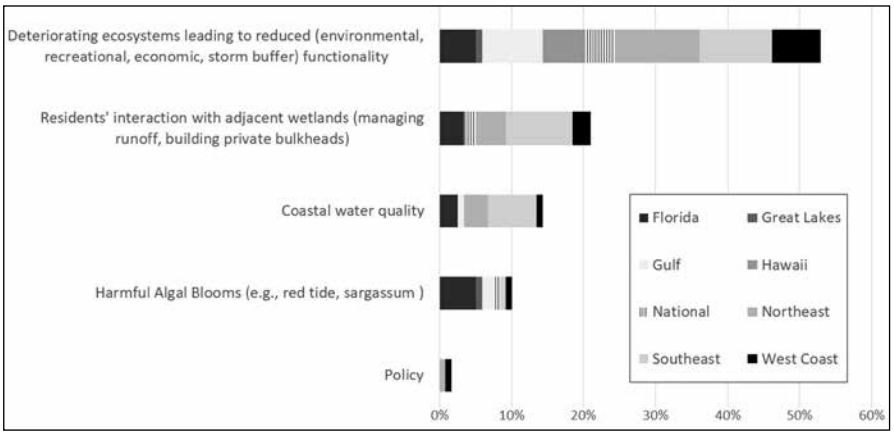


Figure 11. Bar chart of survey respondents' greatest human/ecosystem health management challenges categorized by region.

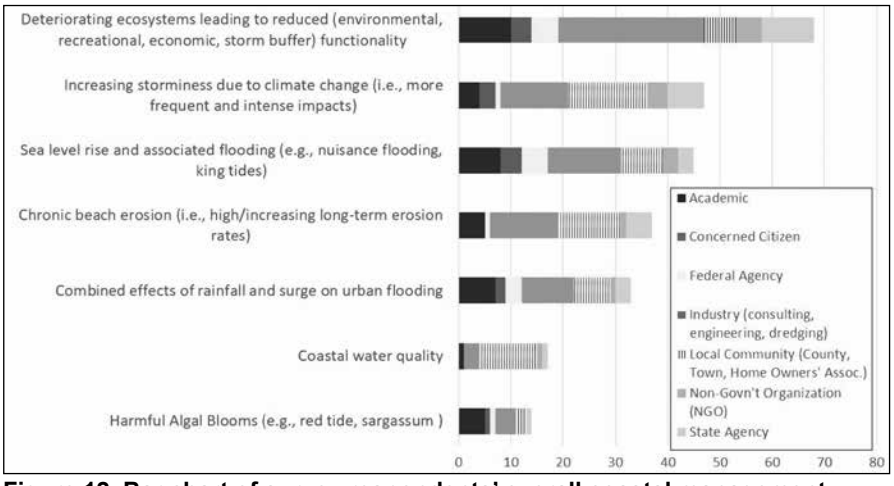


Figure 12. Bar chart of survey respondents' overall coastal management challenges categorized by affiliation.

ions of coastal managers on a national scale. This basic characterization of the respondents provides the appropriate perspective for the substantive analysis of coastal management challenges and needs.

Coastal management challenges and needs by topic area

Within each of the three topic areas, respondents were asked to select their top coastal management challenge from a list of multiple-choice responses based on the survey development methods outlined above.

The top coastal management challenges identified by the survey were:

- Deteriorating ecosystems leading to reduced (environmental, recreational, economic, storm buffer) functionality,
- Increasing storminess due to climate change (i.e. more frequent and intense impacts),
- Coastal flooding, both
  - Sea level rise and associated flooding (e.g. nuisance flooding, king tides), and
  - Combined effects of rainfall and surge on urban flooding,
- Chronic beach erosion (i.e. high/increasing long-term erosion rates), and
- Coastal water quality, including harmful algal blooms (e.g. red tide, sargassum).

These results are consistent with the findings from a similar survey conducted in California in 2016 (Moser *et al.* 2018). The three most commonly mentioned management challenges in that survey were sea level rise, coastal/shoreline erosion, and water quality in coastal/nearshore waters (chosen by 69%, 64% and 57% of respondents, respectively).

The top coastal management challenges identified are not isolated or independent. Deteriorating ecosystems not only reduce ecologic services and functionality, but also sequester carbon which may be disrupted due to climate change (Burden *et al.* 2020). Climate change is also resulting in increased extreme wave events (Masselink *et al.* 2016) and hurricane intensification that when coupled with sea level rise are increasing coastal flooding (Emad Mousavi *et al.* 2009; Woodruff *et al.* 2013). Not considering the combined effects of sea level rise and wave events, global estimates of flooding are underestimated (Vitousek *et al.* 2017). With increasing coastal populations living in low-elevation coastal zones, it is imperative for models to accurately predict the vulnerability of communities to coastal flood events (Neumann *et al.* 2015). Many of these issues are the cause of coastal erosion, where the causes may need to be added to the management plans and policies in addition to considering options of traditional erosion mitigation such as protection, accommodation, managed retreat, and sacrifice (Williams *et al.* 2018). Lastly, water quality challenges are complicated by the spatial and temporal limitations of in situ measurements and monitoring (Bierman *et al.* 2011) and human health issues related to monitoring beach sand bacterial populations (Halliday and Gast

2011). Furthermore, because regions have variable sources of nutrient input to the coastal system, mitigation strategies to address nutrient pollution and water quality will also vary (Howarth and Walker 2002). A careful, systematic, and interdisciplinary approach should direct efforts to identify specific research questions needed to tackle these challenges.

COASTAL MANAGEMENT CHALLENGES

In the following sections, survey responses about the most pressing management challenges are analyzed within each topic area from two perspectives. First, results categorized by the respondents' affiliation are examined. Then, results are categorized by region. Slight differences in percent responded between the affiliation and regional analysis is due to some respondents not providing their region and/or affiliation.

Long-term coastal evolution:

Of those who responded to the question of greatest coastal management problems related to long-term coastal evolution, 35% chose sea level rise and associated flooding (e.g. nuisance flooding, king tides) as their top challenge. Sand resources, policy, and flood maps were not included as multiple-choice selections, but were write-in responses under the selection of "other." When the survey responses are analyzed according to the affiliation of the respondents (Figure 6), local community representatives selected chronic beach erosion as their greatest challenge as compared to sea level rise. State agency representatives, on the other hand, selected existing and new coastal development as their greatest challenge, with beach erosion in second place, and sea level rise in third.

When the same survey responses are assessed considering the region of the responders, it becomes obvious that respondents with a national perspective and those from the Southeast drove the sea level rise selection to the top spot (Figure 7). Respondents from the Gulf and West coasts and Hawaii selected chronic beach erosion as their top long-term management challenge, while respondents from the Northeast chose coastal development as the most pressing long-term problem. Answers from Floridians were split evenly between the top three long-term challenges.

Nevertheless, whether examined from the perspective of affiliation or region, the majority of respondents' long-term coastal management challenge responses are represented by the top two choices of sea level rise and associated flooding and chronic beach erosion.

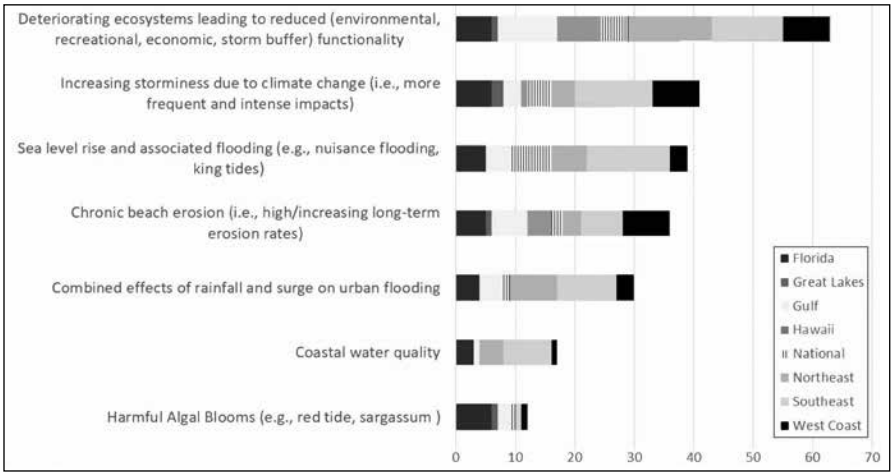


Figure 13. Bar chart of survey respondents' overall coastal management challenges categorized by region.

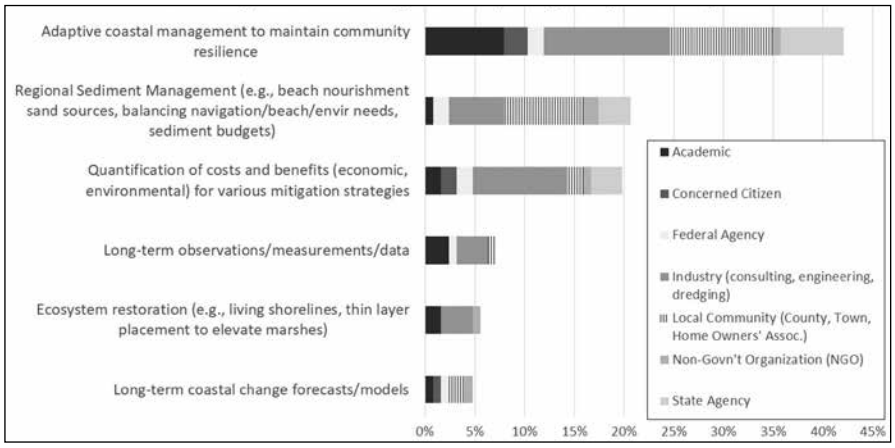


Figure 14. Bar chart of the long-term coastal management tools/strategies survey respondents need help with, characterized by affiliation.

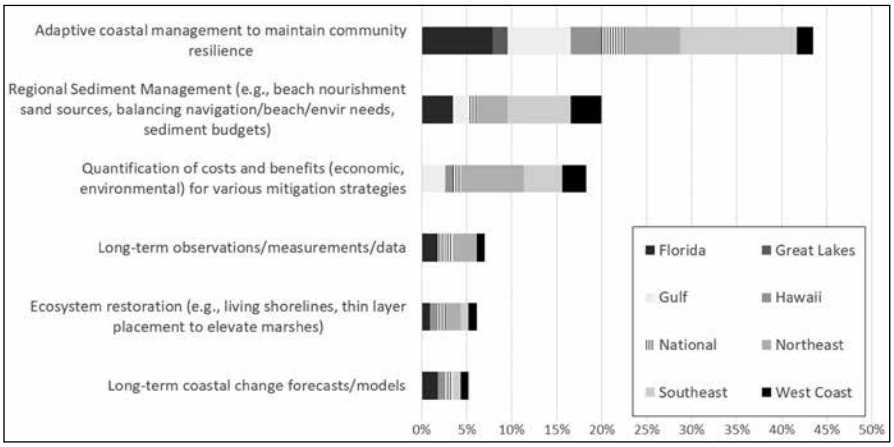


Figure 15. Bar chart of the long-term coastal management tools/strategies survey respondents need help with, characterized by region.

Extreme events

Of those who responded to the question of greatest extreme-event related coastal management problems, 38% chose increasing storminess due to climate change (i.e. more frequent and intense impacts) as their top challenge (Figure 8). In this section, adaptive planning for recovery and policy were not included as multiple-choice selections, but were write-in responses under the selection of "other."

Local community, state agency, and industry representatives agree that their top extreme-event management

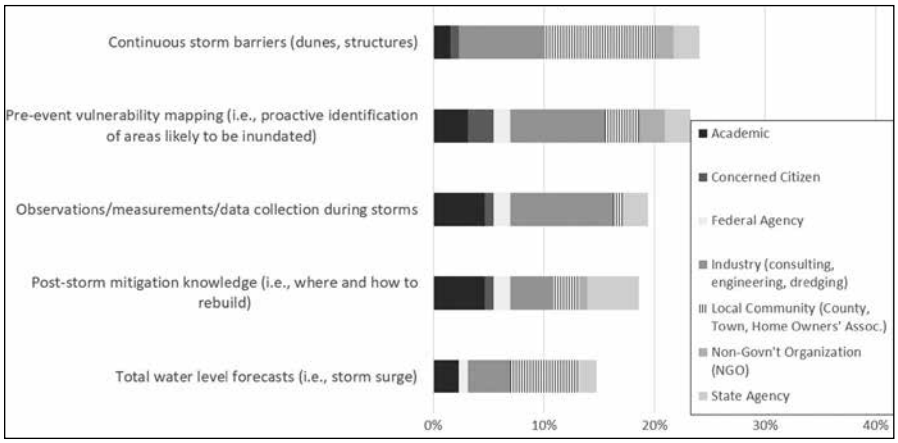


Figure 16. Bar chart of the extreme event-related coastal management tools/ strategies survey respondents need help with, characterized by affiliation.

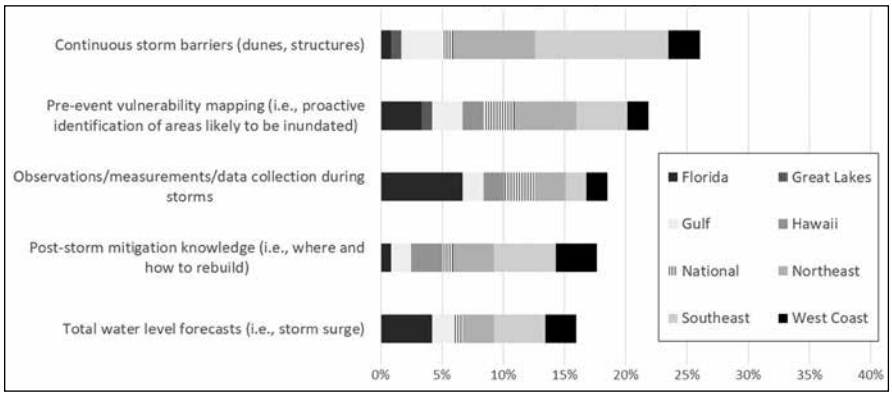
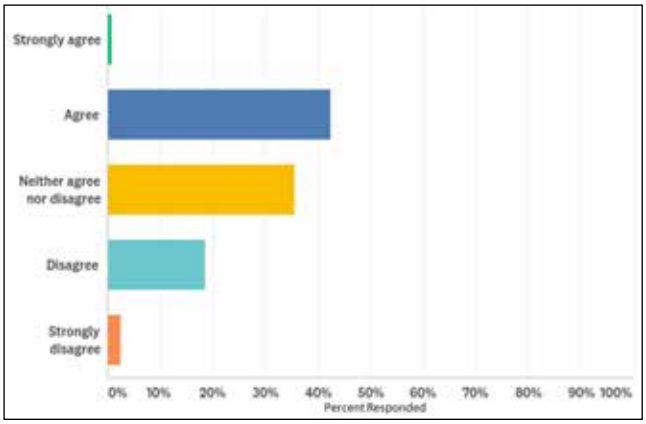


Figure 17. Bar chart of the extreme event-related tools/strategies survey respondents need help with, characterized by region.

Figure 18. Bar chart of survey respondents' feelings about whether information and resources for addressing management challenges are readily available.



challenge is increasing storminess due to climate change (Figure 8). Academics and federal agency representatives selected the combined effect of rainfall and surge on urban flooding as their top choice. Interestingly, no local community representatives selected emergency orders or damage assessments, but a few chose uncertainty in storm forecasts and dangerous surf zone currents.

When the same survey responses are assessed considering the region of the responders, respondents with a national perspective and those from the southeast, West Coast, and Florida selected increasing storminess as their top choice (Figure 9). Respondents from the Northeast and Gulf coasts were more likely to select the combined effects of rainfall and surge on urban flooding as their top choice.

Regardless of affiliation or region, increasing storminess and the combined effects of rainfall and surge were the clear top two challenges in this category.

Human and ecosystem health

Of those who responded to the question of greatest human and ecosystem health coastal management problems, 53% chose deteriorating ecosystems leading to reduced (environmental, recreational, economic, storm buffer) functionality to be their top challenge (Figure 10). This response obtained the largest number of votes for any topic about management challenges. The challenge of "policy" was not included as a multiple-choice selection, but was a write-in response under the selection of "other."

State and federal agency, industry, and academic representatives agree that deteriorating ecosystems leading to reduced (environmental, recreational, economic, storm buffer) functionality is their top human and ecosystem health related management challenge (Figure 10); however, the most popular response from local community representatives was coastal water quality. Respondents from every region selected deteriorating ecosystems as their top choice with the only exception being Floridians who chose harmful algal blooms (Figure 11).

Summary of top coastal management challenges

Overall, the coastal management challenges that respondents chose most frequently were:

- Deteriorating ecosystems leading to reduced (environmental, recreational, economic, storm buffer) functionality,
- Increasing storminess due to climate change (i.e. more frequent and intense impacts),
- Coastal flooding, both
  - Sea level rise and associated flooding (e.g. nuisance flooding, king tides), and
  - Combined effects of rainfall and surge on urban flooding,
- Chronic beach erosion (i.e. high/ increasing long-term erosion rates), and
- Coastal water quality, including harmful algal blooms (e.g. red tide, sargassum).

Deteriorating ecosystems leading to reduced functionality was the most commonly selected challenge overall. However, when responses were delineated by affiliation, the most commonly selected challenge of local community representatives was increasing storminess due to climate change with chronic beach erosion and coastal water quality as their second and third most commonly selected challenges, respectively (Figure 12). When the top challenges are exam-

ined from a regional perspective, harmful algal blooms are the top challenge for Floridians, while respondents with national perspectives and from the Southeast mostly commonly selected sea level rise.

Given that the survey was taken by members of organizations that traditionally focus on beachfront management challenges, an inherent bias toward challenges such as beach erosion would not have been surprising. However, deteriorating ecosystems, increasing storminess, and coastal flooding, both long- and short-term, were the three most commonly mentioned management challenges overall. Chronic beach erosion was the fourth most commonly selected challenge despite the expected inherent bias of the respondents. There appears to be a shift in the top management challenge from chronic beach erosion, which was the challenge being addressed when many of these organizations formed, to the water-related challenges of today.

These results are strikingly similar to those of the California assessment, which found that sea level rise was the dominant management concern in 2018 as opposed to 2011 when sea level rise was seen as a future challenge (Moser *et al.* 2018).

NEEDED TOOLS AND STRATEGIES

During survey development, management challenges were separated from tools and strategies to address long-term coastal evolution and extreme event related challenges.

Long-term coastal evolution

Of those who responded to the question of coastal management tools and strategies they need help with related to long-term coastal evolution, 42% selected adaptive coastal management to maintain community resilience as their top need. All of the responses shown in Figure 14 were offered as multiple-choice options in the survey (i.e. none were write-ins).

When the survey responses are analyzed considering the affiliation of the respondents, all affiliations (including local community representatives) chose adaptive coastal management to maintain community resilience as their top need for assistance related to long-term coastal evolution (Figure 14). Regional Sediment Management was the local community representatives' second choice, while state agency representatives selected quantification of costs and benefits as their second tool or strategy with which they needed help.

When the same survey responses are assessed considering the region of the responders, all regions except the northeast and the West Coast agreed that they need help with adaptation (Figure 15). Respondents from the Northeast expressed the need for help with quantification of costs and benefits, while respondents from the West Coast wanted help with Regional Sediment Management.

Extreme events

Of those who responded to the question of coastal management tools and strategies they need help with related to extreme events, 42% selected continuous storm barriers (dunes, structures) as their top need. All of the responses shown in Figure 16 were offered as multiple-choice

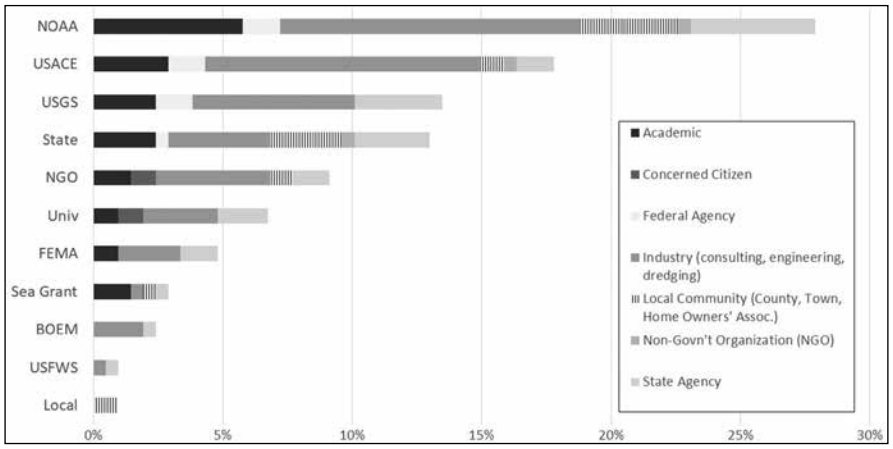


Figure 19 (above). Bar chart of survey responses to the write-in, open-ended question: "Which agencies are providing useful information?"

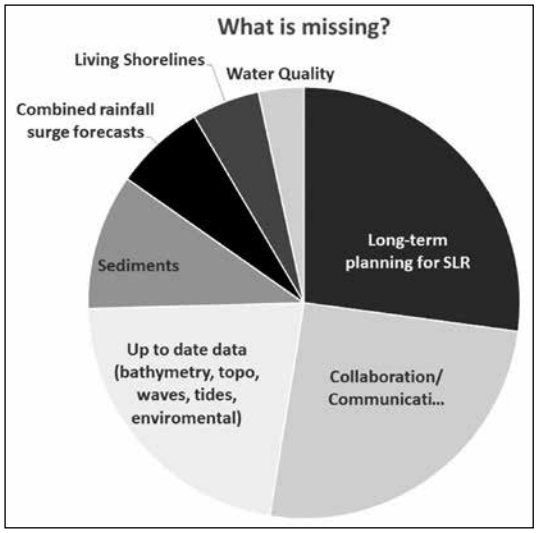


Figure 20 (left). Bar chart of generalized responses to the survey question: "What information is missing? What do you need but can't find?"

Figure 21 (below). Word cloud of open-ended responses to the question: "What information would you like to see agencies provide?"

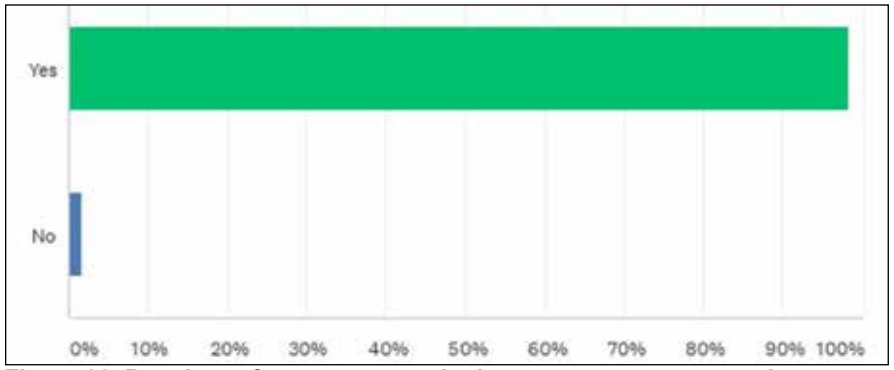


Figure 22. Bar chart of responses to whether or not survey respondents were supportive of funding research to address management challenges.

options in the survey (i.e. none were write-ins). It is interesting that the greatest tool/strategy selected for this topic is a tangible, physical tool while the tool/strategy selected most often under the long-term category could be considered more planning-related.

When the survey responses are analyzed considering the affiliation of the respondents, local community representatives chose continuous storm barriers as their top need for assistance related to extreme events (Figure 16). Total water level forecasts were the local community representatives' second choice, while state agency representatives selected post-storm mitigation knowledge (i.e. where and how to rebuild) as the tool or strategy that they needed the most help with.

When the same survey responses are characterized by region, respondents from the Gulf, Northeast and Southeast agreed on continuous storm barriers as a top need (Figure 17). Respondents from the West Coast and Hawaii expressed the need for help with post-storm mitigation knowledge.

Existing tools and resources

The intent of the final section of the survey on tools and resources was to begin to understand the type and source of information respondents use most regularly in their daily job responsibilities, as well as what they feel is missing or needed. Here, mostly open-ended questions were posed to respondents with the intention of populating queries and develop a more specific survey in future.

Survey respondents indicated that the information and resources needed to effectively address coastal management challenges were not necessarily readily available (Figure 18). Respondents were neutral on average in response to this question. This suggests there is room for improvement in providing information and resources for coastal management challenges. Please refer back to Figure 5 for survey respondents' sources of technical information.

When prompted through an open-ended, write-in response question, 28% of respondents indicated that NOAA was the agency providing useful information (Figure 19). If the Sea Grant responses are included in that percentage, it increases to over 30%. Local community representatives agreed that NOAA was providing useful information. The second most common response to this question by local communities was state organizations. State agency representatives also selected NOAA as the top agency providing useful information. USGS was the second most common response to this question by state agency representatives.

"Information on costs/ benefits of various management techniques is lacking. In particular, issues related to managed retreat and how to both incentivize and maintain local economies with that type of strategy."

When asked "What information is missing? What do you need but can't find?" survey respondents most often mentioned needs in the category of long-term planning for sea level rise (Figure 20). The specific responses included adaptation, managed retreat (e.g. see inset quote), social science, and policy needs related to long-term planning for sea level rise. A few respondents had questions as to the long-term sustainability of beach nourishment. The second most common response to this question fell into the category of collaboration and communication. Specific responses in this category included cross-organization collaboration and frustration dealing with specific agencies. Another common response was related to the need for up-to-date coastal field data on bathymetry, topography, waves, tides, and environmental factors. Responses in the category of sediments were generally related to sand resources and examples of beneficial use of dredged material.

Responses to the question: "What would you like to see agencies provide?" included similar concepts with real-time or up-to-date data and mapping being the most common response. The words data, coastal, and mapping were the three most common words in these responses (Figure 21). Solutions and tools for stakeholders were also a common request from survey respondents. One respondent summed it up by stating: "*There is an abundance of tools that visualize vulnerabilities. Now we need to work towards policy and planning measures that attend to the issue.*"

"There is an abundance of tools that visualize vulnerabilities. Now we need to work towards policy and planning measures that attend to the issue."

Finally, the concept of combining surge and rainfall modeling into improved predictions was also a common response. Combining was the fourth most common word in these responses (Figure 21).

The final question of the survey provided a reassuring response that respondents are extremely supportive of federal funding for research to help address coastal management challenges (Figure 22).

CONCLUSION

The 15-question survey yielded 134 complete responses with an 80% completion rate within an average of seven minutes to complete the survey. Respondents included coastal stakeholders such as local community representatives and their industry consultants, state and federal agency representatives, and academics. Respondents from the East, Gulf, West and Great Lakes coasts, as well as Alaska and Hawaii, were represented.

Overall, the coastal management challenges that respondents chose most frequently were:

- Deteriorating ecosystems leading to reduced (environmental, recreational, economic, storm buffer) functionality,
- Increasing storminess due to climate change (i.e. more frequent and intense impacts),
- Coastal flooding, both
  - Sea level rise and associated flooding (e.g. nuisance flooding, king tides), and
  - Combined effects of rainfall and surge on urban flooding,
- Chronic beach erosion (i.e. high/increasing long-term erosion rates), and
- Coastal water quality, including harmful algal blooms (e.g. red tide, sargassum).

A careful, systematic, and interdisciplinary approach should direct efforts to identify specific research questions needed to tackle these challenges.

While deteriorating ecosystems leading to reduced functionality was the most commonly selected challenge overall, the most commonly selected challenge of local community representatives was increasing storminess due to climate change with chronic beach erosion and coastal water quality as their second and third most commonly selected challenges, respectively. When the top challenges are examined from a regional perspective, harmful algal blooms are the top challenge for Floridians, while respondents with national perspectives and from the Southeast selected sea level rise most commonly.

The survey was taken by members of organizations that traditionally focus on beachfront management challenges; thus, an inherent bias toward challenges like beach erosion might have been expected. However, there appears to be a shift in the most pressing management challenge from chronic beach erosion (ranked fourth here), which was the challenge being addressed when many of these organizations formed, to ecosystem- and water-related challenges today. This shift was also observed by Moser *et al.* (2018).

In terms of coastal management tools and strategies respondents need help, the most common responses were adaptive coastal management to maintain community resilience and continuous storm barriers (dunes, structures) to be their top long-term and extreme event related needs, respectively.

When asked whether the information and resources respondents needed to address their challenges were readily available, the responses were neutral, suggesting there is room for improvement. All respondents, regardless of affiliation, mentioned NOAA most frequently as the organization providing useful information. Local managers mentioned state agencies, while state agencies mentioned USGS second most commonly.

In response to open-ended questions about information that is missing or information that agencies can provide, common responses fell into the following categories:

- Long-term planning for sea level rise,
- Collaboration and communication,
- Up-to-date coastal field data on bathymetry, topography, waves, tides, and environmental factors,
- Solutions and tools for stakeholders (e.g. the quote shown here), and
- Combined rainfall and surge predictions.

The results of this study should be useful in determining future research needed to assist managers in planning and implementation of strategies to tackle the top management challenges identified.

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