Final Evaluation Findings

Grand Bay National Estuarine Research Reserve

December 2007 to August 2016

Published November 2018

Office for Coastal Management
National Ocean Service
National Oceanic and Atmospheric Administration
United States Department of Commerce

Table of Contents

Executive Summary 1

Program Review Procedures 3

Evaluation Findings 4

- Program Administration 4
  - Staffing Turnover – Coastal Training Program Coordinator 5
  - National and Regional Role 5
  - Facilities 6
  - Disasters and Response Planning 7
  - Volunteer Group 7
  - Education Program and Underserved Communities 8
  - Research and Monitoring Program 8
  - Findings for Program Administration 9
- Climate Change 9
  - Research Reserve System Sentinel Sites and NOAA Sentinel Sites 10
  - Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico 11
  - Gulf Coast Vulnerability Assessment 11
  - Erosion Monitoring 11
  - Prescribed Fire and Marsh Migration – Pine Island 12
  - Coastal Resilience Index 12
  - Living Shorelines 12
  - Mud on the Move – Research Reserve System National Science Collaborative Project 13
  - Findings for Climate Change 13
- Water Quality 13
  - Monitoring Impacts of Phosphates 13
  - Impacts of Land-Use Change and Nitrogen Source Shifts over Time 14
  - Blue Carbon 15
  - K-12 Education 15
  - Findings for Water Quality 15
- Evaluation Metrics 16

Conclusion 19

Appendix A: Response to Written Comments 20

Executive Summary

The Coastal Zone Management Act requires the National Oceanic and Atmospheric Administration's (NOAA) Office for Coastal Management to conduct periodic evaluations of the performance of state programs participating in the National Estuarine Research Reserve System. This evaluation examined the operation and management of the Grand Bay National Estuarine Research Reserve by the Mississippi Department of Marine Resources, the designated lead agency, for the period from December 2007 to August 2016. The evaluation focused on three target areas: program administration, climate change, and water quality.

The findings in this evaluation document will be considered by the NOAA Office for Coastal Management in making future financial award decisions concerning the reserve. The evaluation came to these conclusions:

Program Administration

Accomplishment: The Office for Coastal Management commends the Mississippi Department of Marine Resources for its strong support of the Grand Bay Research Reserve throughout the evaluation period and implementation of organizational changes that have improved the administration of the reserve.

Accomplishment: The Office for Coastal Management commends the Grand Bay Research Reserve for designing and building a facility that greatly enhances their ability to conduct research and programming serving the state and local communities.

Accomplishment: The Office for Coastal Management commends the Grand Bay Research Reserve for its leadership in disaster response planning and training which has resulted in strengthened relationships with first responders and has served as a national model for other reserves.

Recommendation: The Office for Coastal Management encourages the Grand Bay Research Reserve to continue to take an active role in regional coastal management efforts including its leadership in building region-wide collaboration between coastal programs and reserves.

Recommendation: The Office for Coastal Management encourages the Grand Bay Research Reserve to continue to build and maintain relationships with emergency responders through hosting or participating in periodic disaster response exercises.

Recommendation: The Office for Coastal Management encourages the Grand Bay Research Reserve to develop and implement a plan for growing a volunteer program and maximizing volunteer support of its programming.

Recommendation: The Office for Coastal Management recommends that the Grand Bay Research Reserve update the last chapter of its site profile, *Monitoring and Research Needs at the Grand Bay NERR*, to help guide future research towards addressing priority needs. In addition, the office encourages the reserve to pursue opportunities to expand its communication of research and research results to coastal managers and others in the Gulf Coast region.

Climate Change

Accomplishment: The Office for Coastal Management commends the Grand Bay Research Reserve for its regional and national leadership in research and monitoring that has increased understanding of the impacts of climate change; for its development as a sentinel site and its contributions towards the development of a national system of reserve sentinel sites; and for its work with local communities providing local science-based information and tools such as the Coastal Resilience Index that foster adaptation and mitigation of potential impacts of climate change.

Water Quality

Accomplishment: The Office for Coastal Management commends the reserve for monitoring the environmental impacts of the 2005 Mississippi Phosphates spill on estuarine habitats, conducting research to better understand potential future impacts, and working with partners towards a long-term solution.

This evaluation concludes that the Mississippi Department of Marine Resources is adhering to the programmatic requirements of the National Estuarine Research Reserve System in the operation of the Grand Bay National Estuarine Research Reserve.

Program Review Procedures

The NOAA Office for Coastal Management evaluated the Grand Bay National Estuarine Research Reserve in fiscal year 2016. The evaluation team consisted of Carrie Hall, evaluation team lead; Matt Chasse, site liaison; Todd Davison, director, Southern region; and Jace Tunnell, director, Mission-Aransas National Estuarine Research Reserve. The support of the reserve staff was crucial in conducting the evaluation, and this support is most gratefully acknowledged.

NOAA sent a notification of the scheduled evaluation to the director of the Mississippi Department of Marine Resources and published a notice of "Intent to Evaluate" in the *Federal Register* on June 22, 2016 (81 Fed. Reg. 40676). NOAA also notified members of Mississippi's congressional delegation. The reserve posted a notice of the public meeting and opportunity to comment in the *Sun Herald* on July 20, 2016.

The evaluation process included a review of relevant documents and a survey of stakeholders, which helped identify three target areas for the evaluation: program administration, climate change, and water quality. A site visit was also conducted August 24-26, 2016, and the evaluation team held meetings with staff members and group discussions with stakeholders and program staff members about the target areas. In addition, a public meeting was held on Wednesday, August 24, 2016, at 4:30 p.m. at 6005 Bayou Heron Road, Room 100, Moss Point, Mississippi, to provide an opportunity for members of the public to express their opinions about the implementation of the reserve. Stakeholders and members of the public were given the opportunity to provide written comment via email or U.S. mail through Friday, September 2, 2016. No written comments were received. The Office for Coastal Management then developed draft evaluation findings, which were provided to the reserve for review, and the reserve's comments were considered in drafting the final evaluation findings.

Final evaluation findings for the national estuarine research reserves highlight each reserve's accomplishments in the target areas and include recommendations, which are of two types:

Necessary Actions address programmatic requirements of implementing regulations of the Coastal Zone Management Act. These must be carried out by the dates specified. Failure to address necessary actions may result in a future finding of non-adherence and the invoking of interim sanctions, as specified in the Coastal Zone Management Act §312(c).

Recommendations are actions that the office believes would improve the program but which are not mandatory. The state is expected to have considered the recommendations by the time of the next evaluation or dates specified.

Evaluation Findings

Program Administration

The Mississippi Department of Marine Resources was restructured in 2013 using the results of a financial audit and organizational review called for by the new executive director. As part of the organizational changes, the reserve reports directly to the chief scientific officer, a new position that reports directly to the executive director. The reserve manager was also made a member of the department's management team. The organizational changes have elevated the standing of the reserve within the department and demonstrate the department's strong support of the reserve and its research.

A job classification survey was performed as part of the reorganization. Based on the survey results, job positions were realigned to better reflect the work being performed by employees. These changes resulted in job position title changes and increased salaries for most reserve employees. The reserve gained two new positions, including a research technician for the System-Wide Monitoring Program and outreach specialist for the Coastal Training and Education Programs. The facilities manager position, which had been a part-time contractor, was made a full-time position.

As part of the department's restructuring, a Grants Management Bureau was created within the finance office. The bureau is responsible for financial accountability and compliance for all grants and is involved in pre- and post-award operations. Other changes relating to the finance office include the creation of a chief financial officer position and annual audits. The establishment of the Grants Bureau removed the task of grant compliance from the reserve, thus providing additional administrative support and more time for reserve staff members to focus on programmatic activities. Grants Bureau personnel are specifically trained in state and federal granting requirements, resulting in improved quality of grant compliance work. The department now has the ability to take and manage grant funds from a variety of sources, and the reserve has been very successful in obtaining grants to support its work. The Office for Coastal Management commends Mississippi Department of Marine Resources for its strong support of the Grand Bay Research Reserve throughout the evaluation period and implementation of changes that have improved the administration of the reserve.

The reserve drafted and adopted its current management plan, *Grand Bay National Estuarine Research Reserve Management Plan 2013-2018*, during the evaluation period. The comprehensive plan has provided the staff with a strong foundation for programmatic success. As the reserve moves into its next management plan cycle, the Office for Coastal Management encourages the reserve to continue to identify the priority coastal management issues it will address and invest staff resources according to staff capacity and the relevance of proposed work to the priority coastal management issues.

Reserve staff members were praised by stakeholders for creating a welcoming atmosphere at the reserve. Stakeholders and the evaluation team were also impressed with the reserve's innovative culture: thinking outside the box and continually trying out new ideas to improve and solve issues. The office commends the new department and reserve leadership for fostering an innovative culture.

Reserve staff members have also worked to strengthen their partnerships with federal, state, and local agencies. For example, a local government leader from the City of Pascagoula noted that they were utilizing reserve research and resources in their efforts to boost the quality of life in their community. The reserve has also continued to strengthen its relationship with the Grand Bay National Wildlife Refuge staff. For example, staff members work closely together to conduct prescribed burns. The office commends the reserve for its strong and evolving partnerships with the U.S. Fish and Wildlife Service and surrounding communities.

During the evaluation period, the reserve was also significantly impacted by the Deepwater Horizon oil spill. In the period immediately following the spill, reserve staff members were almost entirely devoted to response efforts. After the immediate response, the reserve staff supported restoration planning and provided technical support to the natural resource damage assessment process.

Staffing Turnover – Coastal Training Program Coordinator

The reserve was challenged by high turnover in the Coastal Training Program coordinator position during the evaluation period. In the few years before the evaluation site visit, there were four different coordinators, with the last being hired October 2015. In late 2015, the reserve prioritized hiring a new Coastal Training Program coordinator that would be a good long-term fit with the reserve, and the coordinator has remained in the position for over two years. Although the reserve has been challenged by the high turnover rate, several past coordinators are still working in coastal management in the state, providing strong links to other coastal agencies.

National and Regional Role

The reserve provided valuable support to the National Estuarine Research Reserve System, including hosting NOAA guests for the purpose of showcasing the reserve, its contributions to a national network, and its positive impacts in the local community and state. In addition, staff members have served on national reserve committees and contributed their expertise to strengthening core programming across the network. The reserve also hosted members of Mississippi's state legislature, highlighting the significant positive local impacts of the reserve to citizens and coastal communities, such as working with the City of Pascagoula to provide data and identify potential solutions to local water quality issues. The reserve has also worked as part of the Gulf of Mexico Alliance to implement regional priorities, including the development of an avian monitoring program. The reserve's research and Coastal Training Program workshops inform restoration activities in the Gulf. The reserve has been a leader in the region, bringing Gulf-coast coastal programs and reserves together to address coastal issues. The Office

for Coastal Management commends the reserve for its contributions to the national program and support of regional priorities and encourages the reserve to continue to take an active role in regional coastal management efforts including its leadership in building region-wide collaboration between coastal programs and reserves.

Facilities

The reserve completed construction of its new visitor's center and staff offices in October 2009. The reserve's new facilities have allowed the reserve to better serve the community through provision of excellent education and training programs, a visitor center for the general public, and a research hub that provides quality research facilities for visiting researchers. The main building has five wings that create a large courtyard with amphitheater-style seating for outdoor education and interaction among visiting researchers and staff. The research wing includes chemistry, biology, and microbiology laboratories used for research and stewardship projects that enable the department to better understand and manage the state's coastal resources. The dormitory wing facilitates the use of the reserve as a living laboratory by other researchers and educators. The education wing has two classrooms and interpretive exhibits that pertain to the local ecology. The other two wings house administrative office space for the reserve and U.S. Fish and Wildlife Service staffs. A boat shed and maintenance workshop were also built to support reserve activities.

The building was awarded gold certification by the U.S. Green Building Council and is the state's first government-owned LEED-certified building. Reserve staff members designed the exhibits that focus on the theme, "Living on the Edge—The Nature of Change." One exhibit specifically addresses climate change. Each exhibit demonstrates how the visitor is the key to conserving the region's coastal habitats and estuaries. The "Firewise" landscaping around the building includes a special gravel path that allows rainfall to soak into the ground instead of running off and helps provide protection for potential forest fires. There is also a solar panel demonstration project and exhibit built with an U.S. Fish and Wildlife Service Coastal Impact Assistance Program grant. The reserve hosts regular green building tours that highlight and showcase the innovative, sustainable design and materials. The reserve often has architecture classes from local colleges visit and request building tours. The reserve has found that the cutting-edge building and specially designed systems pose some challenges with maintenance and repair but ultimately has been successful in maintaining a well-functioning facility. The elevation of the facilities manager to a full-time position was an important component of this success.
To enhance education opportunities, the reserve planned for a new boat that could be outfitted for large group tours and used for educational and research related activities. The boat will allow the reserve to provide increased marsh habitat access to visitors. The reserve received a Five Star and Urban Waters Restoration Grant from the National Fish and Wildlife Foundation to build the Savanna Trail to increase public access to pine savanna and freshwater wetland habitats. A planned outdoor classroom will facilitate student learning in the freshwater marsh habitats of the reserve. The Office for Coastal Management commends the reserve for designing and building a facility that greatly enhances its ability to conduct research and programming serving the state and local communities.

The entrance road to the reserve is low-lying and prone to flooding. Since the site visit, Jackson County has raised Bayou Heron Road about 4 inches which has prevented flooding in some instances. The reserve is also looking to restore the pine savanna north of the building which will result in increased flood control capacity which may also help alleviate road flooding. The office encourages the Department of Marine Resources and reserve to continue to identify and pursue opportunities to improve road safety. The reserve might benefit from talking to other reserves such as Rookery Bay who have addressed similar problems. This could also provide the reserve with an opportunity to monitor and assess the implementation and long-term success of a transportation resilience project to inform future efforts.

The reserve has been utilizing newer outreach methods such as Facebook, Twitter, a YouTube channel, and drone videos. The office encourages the reserve to continue to use and experiment with new outreach methods to identify effective methods for sharing best practices and success stories.

Disasters and Response Planning

After two successive disasters impacting the reserve, Hurricane Katrina and the Deepwater Horizon oil spill, the reserve initiated an effort to create a disaster response plan that evolved into a Gulf-wide effort supported by the NOAA Disaster Response Center. The reserve's efforts served as a template and model for the National Estuarine Research Reserve System, and all reserves have since developed disaster response plans.

The planning process allowed for increased interaction with local and regional stakeholders and has enhanced the visibility of the reserve system within the response community. Building on the planning effort, the reserve conducted several response exercises with Disaster Response Center funding. Using the reserve's capacity to integrate research, training, education, and stewardship, staff members created a response exercise that included conducting important research. In the summer of 2015, a spill response exercise was conducted with several university partners and the department's marine patrol. A dye study simulating the release of wastewater from a nearby fertilizer plant allowed the participants to investigate where the "phosphate spill" went and the local circulation patterns. The project resulted in a better understanding of circulation patterns and built understanding of the response process, skills of reserve staff, and relationships between potential partners in addressing a future disaster. The Office for Coastal Management commends the Grand Bay Research Reserve for its leadership in disaster planning and training, which has resulted in strengthened relationships with first responders and has served as a national model for other reserves. The office encourages the reserve to continue to build and maintain relationships with emergency responders through hosting or participating in periodic disaster response exercises.

Volunteer Group

The reserve benefits from the assistance of volunteer hours—8,121 hours were contributed over the four years, 2012-2016—but is challenged with growing and maintaining a volunteer group because of its remote location without a large population center nearby. The reserve's

participation in the Mississippi Master Naturalist Program provides an opportunity for expansion of volunteer activities and building relationships with the local community. The Office for Coastal Management encourages the reserve to develop and implement a plan for growing a volunteer program and maximizing volunteer support of its programming.

Education Program and Underserved Communities

The reserve prioritizes working with its local school district, Moss Point, an underserved district that has been underperforming at the state level. By working closely with the district, the reserve has been able to provide a specially designed outdoor program of activities, integrated with the district's curriculum, for all fourth graders and their teachers. On-site field experiences are designed to teach students about coastal resources and to instill a "sense of place" for them in these critical habitats. Many of these on-site experiences are preceded by a classroom visit from the K-12 education specialist to prepare the students for their field experience. In the field, students engage in hands-on activities in a variety of habitats. The program is designed to help expose fourth graders to subjects they will study more in-depth in the fifth grade and take the tests that they must pass to move on in school. Teacher feedback has indicated that participating student test scores have been increasing. The Office for Coastal Management commends the reserve for working with its local school district to assist them with meeting priority educational needs and engaging underserved students in learning about coastal estuaries.

Research and Monitoring Program

The reserve strives to be a "science engine." The reserve has built a robust capacity to monitor environmental conditions throughout the reserve's habitats including a long-term partnership with NOAA's Air Resources Laboratory to maintain a long-term mercury deposition monitoring station that is part of the National Atmospheric Deposition Network. The reserve's facilities, including labs and boats, long-term monitoring data, and staff support, draw outside researchers to the reserve. As discussed in the findings, the research conducted at the reserve is being utilized throughout the Gulf Coast region by coastal managers to improve coastal management.

To further build on this success, the Office for Coastal Management recommends that the reserve update the last chapter of its site profile, *Monitoring and Research Needs at the Grand Bay NERR*, to help guide future research towards addressing priority needs. The reserve and research partners have already addressed most of the monitoring and research needs identified in the 2007 site profile. In addition, there are opportunities for the reserve to expand its communication of research and research results to coastal managers and others in the Gulf Coast region to promote its use. For example, the reserve might provide more research information on its website, create research stories, use transmedia storytelling, or other methods.

Findings for Program Administration

Accomplishment: The Office for Coastal Management commends the Mississippi Department of Marine Resources for its strong support of the Grand Bay Research Reserve throughout the evaluation period and implementation of organizational changes that have improved the administration of the reserve.

Accomplishment: The Office for Coastal Management commends the Grand Bay Research Reserve for designing and building a facility that greatly enhances its ability to conduct research and programming serving the state and local communities.

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Climate Change

The reserve is striving to understand the effects of climate change on the biological, physical, ecological, and socio-demographic components of the reserve. As reflected in their annual operational funding awards, reserve staff members work across sectors to address climate and engage coastal managers in developing research proposals, conducting research, and distributing the results to coastal managers, students, and the general public. Data from the research reserve's monitoring programs are valued and used by researchers in a variety of research projects, many of which are increasing our understanding of the impacts of climate

change. The Office for Coastal Management commends the reserve for its regional leadership in research and monitoring that has increased understanding of the impacts of climate change and for its work with local communities providing local science-based information that fosters adaptation and mitigation of potential impacts of climate change. The office encourages the Grand Bay Research Reserve to continue its efforts to build connections with federal and university partners in support of climate-linked research and monitoring efforts.

A selection of the reserve's climate resilience projects and initiatives is discussed below.

Research Reserve System Sentinel Sites and NOAA Sentinel Sites

The reserve is part of the National Estuarine Research Reserve System's sentinel site effort that aims to understand the effects of changing water levels and tidal dynamics on the composition and distribution of marsh plant communities. As part of this effort, the reserve installed 15 surface elevation tables (SETs) at five sites which will be surveyed twice a year. These sites are also an integral component of the reserve's System-Wide Monitoring Program. Using data derived from Real-time kinematic (RTK) surveys reserve staff members created digital elevation models that will be used to model inundation patterns.

The reserve is also a founding member of the Northern Gulf of Mexico Sentinel Site Cooperative, one of five cooperatives that serve as NOAA sentinel sites. The cooperative leverages the capabilities of three Gulf reserves, NOAA, the Gulf of Mexico Alliance, and other members to assess the impacts of sea level rise and develop capabilities and tools to facilitate conservation of coastal resources by local, state, and regional managers.

The stewardship coordinator took on a leadership role in the reserve system both regionally and nationally in the development and vetting of sentinel site protocols. Serving on both the sentinel site and vertical control working groups, the coordinator provided training and advice to other reserves as they implemented sentinel sites on their respective sites.

The development of the reserve as a sentinel site is drawing new research to the reserve. For example, two projects funded by the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative are a direct result of the sentinel site infrastructure being in place. Coastal managers and other stakeholders will be able to utilize the increased understanding of long-term trends in marsh elevation and vegetation community response in coastal decision making. The information will be used by the reserve and others in the region to guide habitat restoration priorities and to assess and predict future ecological conditions within the Grand Bay estuary. Data have also been used to validate estuary modeling efforts, including the Sea Level Affecting Marshes Model. The Office for Coastal Management commends the reserve for its development as a sentinel site and its contributions towards the development of a national system of reserve sentinel sites.

Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico

The reserve and partners, including the Apalachicola and Weeks Bay Research Reserves and University of Central Florida, were awarded funding in 2010 by the NOAA National Centers for Coastal Ocean Science, to conduct a five-year project, "Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico." The project built on laboratory experiments, field observations, and experiments conducted at the three reserves. Reserve staff members assisted with field experiments looking at the effects of sea level rise on oysters (using oyster ladders) and emergent marsh vegetation (using marsh organs). The project utilized the information gained from field experiments, as well as existing physical and biological-based models, to inform a suite of predictive models that forecast intertidal marsh evolution and other marsh, seagrass, and oyster habitat models. The Coastal Training Program worked with partners to conduct multiple focus group meetings to identify participants' needs and future uses of the sea level rise predictive tools. This effort provided coastal managers with information and models that support assessing marshes, oyster reefs, and submerged aquatic vegetation; predicting wetland stability; and identifying restoration locations for marsh and oyster habitats. Coastal managers can use the information to prioritize risk management strategies, reformulate setback requirements, improve guidelines for construction of breakwaters and other coastal infrastructure, and assess water resources impacts and protection needs. The reserve staff and program capabilities were key assets in the successful implementation of this project.

In 2016, the partners received additional funding for a five-year project to build on their previous work. Project partners will apply coupled hydrodynamic and marsh models to evaluate the potential for natural and nature-based features to mitigate flood risk under multiple scenarios, and will quantify the economic and ecosystem value of these features in the Northern Gulf of Mexico.

Gulf Coast Vulnerability Assessment

Grand Bay Research Reserve staff members participated in the *Gulf Coast Vulnerability Assessment* (2015), including coordinating the tidal marsh portion of the effort, serving as habitat and species technical experts, and serving as co-author of the report, *Gulf Coast Vulnerability Assessment of Mangrove, Tidal Emergent Marsh, Barrier Islands and Oyster Reef.* The assessment was a collaborative effort of various agencies, institutions, and nongovernment organizations to evaluate the vulnerability of four key ecosystems and 11 associated species to the effects of climate change, sea level rise, and land-use change across the U.S. portion of the Gulf of Mexico. The assessment informs land managers, researchers, and decision makers about the relative vulnerability across individual species and ecosystems and how that vulnerability varies spatially across the Gulf Coast region.

Erosion Monitoring

Shoreline erosion at Grand Bay varies spatially in magnitude and is dependent on shoreline orientation, depositional characteristics, and vegetation structure. In 2004, staff members began monitoring six locations across the reserve where marshes are exposed to open water.

Over the years, six additional sites were added. The sites vary in orientation, localized wave energy and length. Points are collected four times per year (seasonally) and before and after large storm events, following the vegetation line at each site. The U.S. Geological Survey has used the data to derive estimates of shoreline retreat in the reserve. The reserve's monitoring is increasing understanding of marsh erosion in the reserve.

Prescribed Fire and Marsh Migration – Pine Island

Partnering with the U.S. Environmental Protection Agency and the Gulf of Mexico Foundation, the reserve conducted research to better understand the role of prescribed fire for facilitating landward migration of coastal marshes. The project was a collaboration between university researchers and resources managers, including coastal program staff members, from project development to distribution of results. Reserve staff members and partners conducted research to determine differences in marshes treated with prescribed fire compared to those that were not subject to fire. The project integrated the reserve's education and training capabilities into the overall design and included the development of new curricula for schools and workshops for local coastal managers to inform them of the research results.

Coastal Resilience Index

The Grand Bay and other Gulf Coast Coastal Training Programs, along with additional partners, developed the Coastal Storms Community Resilience Index with funding from the NOAA Gulf of Mexico Coastal Storms Program. The index is a simple, inexpensive method to identify weaknesses a community may want to address before the next hazard event. At Grand Bay, the Coastal Training Program coordinator piloted the index with a local community, bringing community leaders together to guide a discussion about their community's resilience to coastal hazards using this tool. Using feedback, the resilience index has been expanded and a Fisheries Resilience Index, Ports Resilience Index, and Tourism Resilience Index have also been developed. The indexes have also served as a model for other states interested in developing a similar rapid assessment tool.

Subsequently, in 2014, the Gulf Coast research reserves obtained three years of additional funding from the U.S. Environmental Protection Agency's Gulf of Mexico Program for the Gulf of Mexico Coastal Training Program Initiative. The project provided support for a regional training coordinator to partner with reserves and work with local communities to build resilience. At Grand Bay, the Coastal Training Program coordinator and the regional training coordinator worked with communities using the Coastal Resilience Index and provided follow-up training and technical assistance for communities that had completed the index. The NOAA Office for Coastal Management commends the reserve for its work with partners to develop the Coastal Resilience Index and assist communities with assessing their resilience.

Living Shorelines

The reserve serves as a testing ground for emerging restoration technologies and techniques. In response to erosion and shoreline degradation adjacent to the Bayou Heron boat ramp, the stewardship team designed and installed a low-cost shore stabilization project in 2009-2010.

Reserve staff members worked with volunteers from a nearby elementary school to install approximately 80 feet of living shoreline stabilization, utilizing coir logs and black needle rush plantings. The site is now well stabilized and has been used as a demonstration site during several Coastal Training Program workshops. In 2015, the stewardship coordinator presented a webinar on the project as part of a NOAA and U.S. Fish and Wildlife Service Restoration webinar series. The Coastal Training Program has also worked with the Weeks Bay and Apalachicola Research Reserves to provide coastal decision makers with up-to-date science on restoration of coastal habitats and living shorelines. A series of workshops has helped to develop and communicate best practices.

Mud on the Move – Research Reserve System National Science Collaborative Project

Grand Bay Research Reserve and other partners were part of a San Francisco Bay Reserve-led Science Collaborative Project, Mud on the Move. The project goal was to provide tidal marsh managers and the regulatory community with a standardized, user-friendly sampling protocol to assess suspended sediment concentrations above tidal marshes. Grand Bay Research Reserve staff members tested and applied the new protocol and explored how differences in tidal regimes, marsh characteristics, and vegetation affected protocol implementation and resulting data. The results of this project have led to new understandings about how sediment is transported over the marsh plain and the user-friendly protocol allows reserves to collect data that will enhance the reserves' Sentinel Site Program.

Findings for Climate Change

Accomplishment: The Office for Coastal Management commends the Grand Bay Research Reserve for its regional and national leadership in research and monitoring that has increased understanding of the impacts of climate change; for its development as a sentinel site and its contributions towards the development of a national system of reserve sentinel sites; and for its work with local communities providing local science-based information and tools such as the Coastal Resilience Index that foster adaptation and mitigation of potential impacts of climate change.

Water Quality

Monitoring Impacts of Phosphates

The reserve's water quality monitoring data are being used by the Mississippi Department of Environmental Quality to monitor the impacts of the abandoned Mississippi Phosphates fertilizer plant on the border of the reserve. In 2005, Mississippi Phosphates had a large catastrophic spill as berms collapsed, sending 17 million gallons of phosphate-laden water into the estuary and changing the pH from 7.5 to less than 3 in 30 minutes. This resulted in a significant die-off of various marine resources including fish and oysters. The reserve's monitoring data were used as evidence of a spill and damage in court, and the Department of Environmental Quality and reserve obtained compensation for damages. After Hurricane Isaac in 2012, high levels of phosphates have continually been found within the reserve boundary. In late 2014, the fertilizer plant went bankrupt and ceased fertilizer manufacturing. Phosphate

levels have decreased but remain elevated. The reserve continues to conduct extensive nutrient sampling to monitor the impact of Mississippi Phosphates and provides data to the Department of Environmental Quality and US Environmental Protection Agency.

The reserve formed a Phosphate Working Group with partners from Dauphin Island Sea Lab, the University of West Florida, the University of Southern Mississippi's Gulf Coast Research Laboratory, and the Department of Environmental Quality. The goal of the working group is to understand phosphate dynamics in the area to facilitate mitigation and remediation activities. In December 2013, the group received a grant from the Mississippi Water Resources Research Institute and U.S. Geological Survey to further explore the biological and ecological effects of the spill. The working group then received funding for a second year and continued field work, including conducting a dye study in conjunction with the reserve's disaster response exercise. Data from the dye study allowed resource managers in the area to better understand and predict the movements of phosphate-laden water should another spill occur. The Office for Coastal Management commends the Grand Bay Research Reserve for monitoring the impacts of the spill, conducting research to better understand potential future impacts, and working towards a long-term solution.

Impacts of Land-Use Change and Nitrogen Source Shifts over Time

The research reserve successfully applied for a science collaborative grant for the project, "Impacts of Land-Use Change and Nitrogen Source Shifts over Time: Building Capacity for Collaborative Research Leadership at the Grand Bay Reserve." The project was a collaborative effort between the research reserve and the Dauphin Island Sea Lab, along with other partners including the U.S. Food and Drug Administration Office of Food Safety, Gulf Coast Research Laboratory, and the Auburn University Shellfish Laboratory. The project aimed to improve the ability to predict the impact of watershed development on the health and function of coastal habitats and their associated resources, such as shellfish beds.

The research reserve engaged the coastal management community at the beginning of the project. Coastal Training Program workshops were held with local oystermen to facilitate information sharing as well as get input on their needs to guide the development of the project proposal. The project capitalized on the Native American shell middens found throughout the reserve and looked at the nitrogen content of the oyster shells to understand the legacy effects of land-use change on coastal ecosystems and human health. This information was combined with data from land-use models, sediment cores, modern sediment and water samples, and living oyster shells to define the effects of land-use change through time and improve the accuracy of current shellfish area closures.

Municipal officials and wastewater treatment plant representatives have used project data to make decisions about operations at a wastewater treatment plant and demonstrated the efficacy of the plant at reducing fecal indicator microbes. Mississippi's Utility Authority and the U.S. Food and Drug Administration used project data to evaluate the effects of effluent from the wastewater plant on local shellfish beds. Additionally, an eco-tour business has used project

information to enhance naturalist tours in the Grand Bay area. The team also identified a phosphate spill, and team members shared project data with the Alabama Department of Environmental Management to address the spill's environmental implications and identify future sampling and monitoring actions to minimize spill effects.

At the end of the project, another stakeholder workshop was held and researchers presented their research and asked for participant feedback on relevant tools that they could use related to the research. Stakeholders decided on two major products of interest: a quantitative tool to predict how future land-use change will affect water quality (nutrients and pathogens) and educational materials or programs targeted at local citizen groups, from ecotourism to municipal officials. The reserve and partners successfully applied for a science collaborative grant starting in 2017 for the development of educational outreach materials.

Blue Carbon

The reserve partnered with the Weeks Bay and Gulf Regional Coastal Training Programs to provide trainings on using blue carbon as a management tool for conservation and restoration of coastal wetlands. The workshops provided planners, practitioners, and other restoration specialists with a perspective on blue carbon concepts, market and policy opportunities to increase the value of wetland conservation and restoration, and the importance of their integration in restoration and conservation planning and practice.

K-12 Education

The reserve's education program includes opportunities for students to learn about water quality. The reserve has a core group of On-the-Road programs and on-site field experiences that can be adapted to the needs of most teachers. The programs are for elementary and middle school audiences and include lessons conducted in the classroom and a field visit to the reserve. Programs include Water Quality on the Road and Marine Litter Stewardship on the Road. The programs were designed using feedback from local teachers.

The reserve had three B-WET grants during the evaluation period, including a grant, "Connecting Kids to Coastal Watersheds-Identification and Characterization of Gulf Habitats through Environmental Education." The reserve worked with the University of Southern Mississippi and the Land Trust for the Mississippi Coastal Plain to develop an entire curriculum for the Pascagoula River watershed. A second B-WET grant, "Coastal Watershed Connections: Student Impact, Stewardship and Reflections," involved providing students with the opportunity to travel to the reserve and learn about watersheds through field activities.

Findings for Water Quality

Accomplishment: The Office for Coastal Management commends the Grand Bay Research Reserve for monitoring the environmental impacts of the 2005 Mississippi Phosphates spill on estuarine habitats, conducting research to better understand potential future impacts, and working with partners towards a long-term solution.

Evaluation Metrics

Beginning in 2012, national estuarine research reserves began tracking their success in addressing three evaluation metrics specific to their programs. The evaluation metrics include a five-year target and provide a quantitative reference for each program about how well it is meeting the goals and objectives it has identified as important to the program.

The goals and objectives are from the draft Grand Bay National Estuarine Research Reserve (NERR) Management Plan dated 2012.

METRIC 1

Goal: By 2017, researchers, educators and local communities will develop a better understanding and knowledge of coastal resources that will be utilized to minimize impacts on water quality, habitats, and ecological processes.

Objective: By 2017, K-12 students will have increased insight into conservation needs gained through education, research, and monitoring programs at the Grand Bay NERR.

Strategy: Grand Bay NERR staff members will work to develop and implement student curriculum that will promote the stewardship of our coastal resources, at the reserve and in offsite learning situations. Pre- and post-program testing will be used to determine student awareness and understanding of the importance of stewardship and conservation and potential impacts from climate change.

Performance Measure: From 2012 to 2017, number of K-12 students who participate in Grand Bay NERR programs and are made aware of and understand the importance of stewardship and conservation in our coastal estuaries and the potential impacts from climate change.

Target: From 2012 to 2017, 1,500 K-12 students participate in Grand Bay NERR programs and are made aware of and understand the importance of stewardship and conservation in our coastal estuaries and the potential impacts from climate change.

First Year Results:	6,588 students
Second Year Results:	3,453 students
Third Year Results:	3,336 students
Fourth Year Results:	1,740 students
Fifth Year Results:	4,835 students
Total:	19,952 students

Discussion: The reserve had an approved 5-year target of 1,500, but this may have been a typographical error. The reserve greatly exceeded the target with almost 20,000 students reached.

METRIC 2

Goal: By 2017, local communities will make improved, science-based decisions regarding management of coastal resources and watersheds.

Objective: By 2017, Coastal Training Program workshop participants will use reserve scientific knowledge and expertise to make informed coastal management decisions.

Strategy: Grand Bay NERR staff will hold workshops and training programs that provide reserve-generated science-based information, current status, and trends of natural resources and natural resource management regarding reserve priorities of water quality, climate change, and habitat protection.

Performance Measure: From 2012 to 2017, number of Coastal Training Program workshops and training programs held utilizing reserve or partner-specific research, stewardship data, or stewardship expertise to address reserve priorities of water quality, climate change, and habitat protection.

Target: From 2012 to 2017, 30 Coastal Training Program workshops and training programs held utilizing reserve or partner-specific research, stewardship data, or stewardship expertise to address reserve priorities (water quality, climate change, and habitat protection).

First Year Results: 22 workshops
Second Year Results: 19 workshops
Third Year Results: 15 workshops
Fourth Year Results: 10 workshops
Fifth Year Results: 10 workshops

Total: 76 workshops

Discussion: The reserve was able to more than double its target and more than triple the 25 trainings required for a minimally performing Coastal Training Program. The reserve's success in partnering with the other four Gulf Coast research reserves to obtain additional funding for a regional training coordinator helped expand the reserve's ability to provide quality training workshops.

METRIC 3

Goal: By 2017, Grand Bay NERR develops connections with local communities to increase the public's overall appreciation and significance of coastal ecosystems.

Objective: By 2017, reserve volunteers will have insight into conservation needs gained through involvement with education, research, and monitoring programs at the reserve.

Strategy: Grand Bay NERR staff members will promote citizen and volunteer involvement in reserve education, research, monitoring, and stewardship efforts. Increased volunteer engagement in reserve activities reflects a link to local communities and an appreciation of coastal ecosystems.

Performance Measure: From 2012 to 2017, number of volunteer hours contributed in support of reserve education and training, research, and stewardship activities.

Target: From 2012 to 2017, 2,500 volunteer hours are contributed in support of reserve education and training, research, and stewardship activities.

First Year Results: 2,444 volunteer hours
Second Year Results: 391 volunteer hours
Third Year Results: 1,226 volunteer hours
Fourth Year Results: 4,060 volunteer hours
Fifth Year Results: 1,565 volunteer hours

Total: 9,686 volunteer hours

Discussion: Although, the reserve does not have a volunteer coordinator and the results fluctuate significantly year to year, the reserve met its target within the first two years. The reserve has the potential of developing a more robust volunteer program with consistent higher volunteer support across years.

Conclusion

For the reasons stated herein, I find that the state of Mississippi is adhering to the programmatic requirements of the Coastal Zone Management Act and its implementing regulations in the operation of its approved Grand Bay National Estuarine Research Reserve.

These evaluation findings contain four recommendations that must be considered before the next regularly scheduled program evaluation. Program recommendations that must be repeated in subsequent evaluations may be elevated to necessary actions.

This is a programmatic evaluation of the Grand Bay National Estuarine Research Reserve that may have implications regarding the state's financial assistance awards. However, it does not make any judgment about or replace any financial audits.

signed by Keelin S. Kuipers
Jeffrey Payne, Ph.D., Director
NOAA Office for Coastal Management

dated November 15, 2018
Date

Appendix A: Response to Written Comments

No written comments were received.