GOMESA PHASE II PROJECT FUNDING

Request for Funding FY2026

Submission ID: #202506201326

PROJECT SUMMARY

1. Title of Project

Developing model-based decision support tools and advancing understanding of tipping points in coastal wetlands

2. Location of Project

Grand Bay NERR with limited upland sediment input and managed with prescribed fires; Pascagoula Bay with abundant sediment from upland sources without prescribed fires; Graveline Bay, adjacent to urban development and influenced by local upland input.

3. Requesting Organization:

The University of Southern Mississippi

4. Requesting Agency Representative

a. Name: Erica Kennedy

b. Phone: 601-266-4119

d. Email: ORA-PAM@usm.edu

c. Address: Office of Research Administration

118 College Drive #5157

Hattiesburg Mississippi

5. Funding Requested:

$342715

6. Have any other State or Federal funding sources been identified for the project?

No

7. If yes, enter amount and source of additional funds:

$

Source of Additional Funds:

8. Total Project Funds

$342715

9. Provide Brief Project Description/Overview:

This proposed project aims to improve the conservation of coastal wetlands in Mississippi, which are essential to biodiversity, storm surge protection, and the livelihoods of coastal communities. It addresses four key questions: (1) how sea-level rise (SLR) and saltwater intrusion affect salt marsh vegetation and marsh landscapes; (2) what are the thresholds/tipping points of SLR and salinity stress for salt marshes; (3) how urban development impacts marsh migration; and (4) how restoration strategies (e.g., prescribed fire, living shorelines, thin-layer placement, land acquisition) improve resilience. We will test three hypotheses. H1: Landward migration cannot keep pace with salt marsh loss under SLR. H2: SLR and salinity thresholds are higher in salt marshes with abundance sediment input. H3: SLR and salinity thresholds are higher with restoration practices, demonstrating restorations help improve salt marsh resilience. We will study three representative estuarine systems—Grand Bay, Pascagoula Bay, and Graveline Bay—using integrated fieldwork, experiments, and modeling. Data from each estuary will help develop a modeling framework to predict salt marsh loss and landward migration under SLR, saltwater intrusion, urban development, and restoration scenarios. The framework builds on an existing landscape model developed in the PI's lab, which currently focuses on salt marsh vegetation and inundation and erosion-driven marsh loss (Wu et al. 2020). We will expand it by incorporating salt marsh migration driven by geophysical factors such as SLR and saltwater intrusion and available suitable land, as well as biological factors like species tolerance and interspecific competition. This model will help identify salinity and inundation stress tipping points for salt marshes, accounting for landward migration rates. Prior studies often focus on migration potential but rarely address rate, which is critical for comparing with marsh loss rates to provide a fuller picture of future marsh area. We will then develop model-based decision support tools with user-friendly interfaces, guided by input from resource managers (see support letter). By incorporating tipping points, the research provides early warning of marsh changes and supports more informed conservation planning. The products will include model, tipping points, decision tools, predictive maps at 5-yr intervals through 2050 to guide conservation/restoration priorities under future SLR and development scenarios.

10. LIST Project Goals/Objectives:

The goal of this proposal is to advance our understanding of the resilience of coastal wetlands by examining both loss mechanisms driven by inundation and erosion, and landward migration processes. We also aim to evaluate how different restoration strategies can enhance coastal wetland resilience under future climate and development pressures. To support conservation and management, we will develop model-based decision support tools that allow resource managers and researchers to explore projected salt marsh landscapes under various scenarios, including SLR, urban expansion, and management practices such as land acquisition, prescribed fire, living shorelines, and thin-layer sediment placement. Salt marshes in Mississippi are primarily composed of Spartina alterniflora and Juncus roemerianus. While Spartina alterniflora is well studied due to its dominance across much of the Atlantic and northern Gulf coasts, Juncus roemerianus remains relatively under-researched. Our project addresses this critical knowledge gap by focusing on the vegetation dynamics of Juncus roemerianus, which is especially important for the unique marsh systems found in Mississippi and similar regions. Additionally, we will identify key salinity and inundation stress thresholds for salt marshes. These thresholds will serve not only as scientific benchmarks but also as tools to communicate resilience concepts in accessible terms for stakeholders and policymakers. They will function as early warning indicators of marsh vulnerability, helping guide timely and proactive conservation efforts.

This proposed research has four primary objectives that support the overarching goals: (1) Model the impacts of sea-level rise and urban development on salt marsh vegetation and landscape dynamics, informed by field data on vegetation, soil, and water samples; (2) Derive sea-level rise and salinity stress thresholds for salt marsh ecosystems to serve as indicators of resilience and early warning signals; (3) Identify vulnerable areas that would benefit most from targeted conservation or restoration efforts, and evaluate the effectiveness of strategies such as prescribed fire, living shorelines, thin-layer placement, and upland land acquisition that supports landward marsh migration; (4) Develop decision support tools based on the modeling framework, featuring a user-friendly interface and customizable management scenarios, to help resource managers make informed planning and policy decisions.

11. Which of the following authorized uses set forth in the GOMESA Act does this project fall under? Explain SPECIFICALLY and in detail how the project meets the required criteria. Check all that apply - At least one must be checked.

☒ (A) Projects and activities for the purposes of coastal protection, including conservation, coastal restoration, hurricane protection, and infrastructure directly affected by coastal wetland losses

This project will provide research support for the long-term conservation and management of coastal wetlands in Mississippi's Coastal Preserves, which are essential to biodiversity, fisheries, and the protection of coastal communities. By developing a robust, science-based modeling framework, the project will enable reliable predictions of salt marsh loss and migration under scenarios of sea-level rise, urban development, and restoration efforts. These insights will empower coastal resource managers and other stakeholders to make informed, forward-looking decisions that enhance ecosystem resilience. The project will deliver user-friendly, model-based decision support tools co-developed with resource managers, allowing them to prioritize actions.

☒ (B) Mitigation of damage to fish, wildlife, or natural resources.

This project will support the conservation of fish and wildlife by protecting their critical habitats—coastal wetlands. More than 75% of commercial and 90% of recreational fish and shellfish harvested in the U.S. rely on coastal wetlands for food or habitat during some part of their life cycle (https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=301&object_id=304). Enhancing the conservation of these wetlands will help sustain vital coastal natural resources, preserve biodiversity, and support the many species that depend on them.

☐ (C) Implementation of a federally-approved marine, coastal, or conservation management plan

☐ **(D) Mitigation of the impact of Outer Continental Shelf activities through funding of onshore infrastructure projects.**

12. Project Timetable/Milestones:

Despite their importance to human well-being, coastal wetlands have experienced significant loss and degradation in recent decades due to sea-level rise (SLR), more frequent and severe droughts, storms, hurricanes, oil spills, and increased subsidence from oil and gas exploration etc. To support their conservation, we will develop a modeling framework that captures the interactions, feedbacks, and landscape connectivity driving salt marsh loss and landward migration. This framework will enable projections of future marsh change, tipping points, and the evaluation of potential management strategies. Through engagement with coastal resource managers on the Mississippi Gulf Coast, we identified critical needs for 25-year projections of salt marsh change, a better understanding of urban development's influence on marsh migration, and guidance on where and which restoration practices can enhance resilience to SLR. Our approach integrates modeling, field observations, and experimental work, leveraging existing data, models, and prior projects. We will collect field data along transects to improve an existing landscape model developed in the PI's lab—currently focused on marsh loss—by expanding it to simulate landward migration. The enhanced model will account for accretion, erosion, upland availability, species tolerance, and interspecific competition. We will co-develop model-based decision support tools to predict the effects of SLR and management practices at the landscape scale and derive salinity stress and SLR tipping points. These tools will also incorporate the effects of nearby urban development to inform conservation and restoration priorities.
Milestone 1: Field Campaign. We will establish five transects per estuary across salinity and elevation gradients, from salt marshes to pine savannas, with a focus on less studied ecotones (transition zones from marshes to uplands). Each transect, running perpendicular to the shoreline, will include eight ecotone sites, five salt marsh sites, and five coastal forest sites. At each site, we will measure elevation, vegetation productivity (biomass, DBH, height), density, and soil properties etc. Some transects will cover restoration projects or past prescribed fires,and some will account for canopy shading. Dominant vegetation will be identified, and a regression tree will be trained using Sentinel-2 imagery. Transects will be established in February 2026, with major field and lab work in 2026–2027 and auxiliary data collection (e.g., DBH) in 2028 for model refinement.
Milestone 2: Model Development. We will model vegetation productivity as a function of competition (e.g., for light and nutrients) and geophysical factors like porewater salinity and elevation, a proxy for inundation. This will form the basis of an

individual-based model for marsh migration, coupled with suitable uplands for marsh migration and our existing landscape model focused on marsh loss. Model development will begin in Fall 2026, complete in 2027, and be refined in 2028.
Milestone 3: Threshold/tipping point Analysis. We will run the calibrated model under different SLR and salinity scenarios and compute marsh area and landscape metrics (Wu 2019). Sigmoidal regression curves will be fitted to landscape metrics vs. SLR/salinity to derive tipping points using inflection points (Wu et al. 2020). This work will conclude in 2028.
Milestone 4: GIS & Scenario Analysis. We will identify vulnerable areas and simulate marsh changes under varying SLR, development, and restoration scenarios. This will help identify effective strategies for restoration, land use planning, and climate adaptation. This analysis will begin in late 2027 and continue into 2028.
Milestone 5: Decision Support Tools. We will develop interactive, model-based decision tools using R-Shiny to support resource managers. Interface options (e.g., scenarios, years) will be guided by managers. A beta version will be tested in 2028.
We will hold biannual meetings with managers in 2026–2027 and quarterly meetings in 2028. One M.S. student will graduate in 2027 and one Ph.D. student in 2028. Findings will be disseminated through conferences, workshops, and publications (2027–2028).
References: 1) Wu, 2019. Ecological Indicators 103, 260–271.
2) Wu et al., 2020. Science of the Total Environment 718 (2020) 137181.

13. Project Timing

Short-term (3 year or less)

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APPLICATION SUMMARY QUESTIONNAIRE

14. Current status of architectural/engineering plans & specifications for this project (if applicable):

Group 1:

NA

Group 2:

Funds not budgeted

15. In what way does this project meet the goals and objectives of the Department of Marine Resources, which includes enhancing, protecting and conserving the marine interest of Mississippi for present and future generations.?

This proposal focuses on the conservation of Mississippi's coastal wetlands, which are critical to maintaining ecological integrity, sustaining fisheries productivity, and improving community resilience in the face of sea-level rise, hurricanes, and urban development. The study areas are located within the Mississippi Coastal Preserves, which are actively managed by Mississippi Department of Marine Resources (MDMR). By centering our efforts on salt marsh systems in these preserves, the project is designed to collaborate closely with coastal resource managers and stakeholders, and explicitly advances MDMR's mission to "restore, enhance, protect, and manage Mississippi's remaining coastal estuarine marsh ecosystems" through a combination of innovative modeling, stakeholder engagement, and decision-making tools.
To accomplish this, the project will deliver three key products that support informed planning and proactive conservation: 1) A co-produced decision support tool, developed in collaboration with resource managers and iteratively tested to ensure usability and alignment with real-world management needs. This tool will allow exploration of future marsh conditions under different SLR, land use, and restoration scenarios. 2) Sea-level rise and salinity stress thresholds, derived from field data and modeling, that serve both as technical indicators of marsh vulnerability and as effective communication tools to translate resilience science into early warning signals and management triggers. 3) Spatially explicit maps projecting salt marsh distribution through 2050, updated at five-year intervals, to visually illustrate the impacts of sea-level rise, development, and restoration strategies on marsh landscapes. These maps will help guide conservation priorities and restoration planning over time.
Furthermore, the strategic selection of study sites within representative Coastal Preserves ensures that the tools and findings will be scalable and transferable, with potential for application across broader regions along the Gulf Coast and beyond. Additionally, while Spartina alterniflora has been extensively studied due to its widespread dominance across the Atlantic and northern Gulf coasts, Juncus roemerianus, a species particularly prevalent in Mississippi, remains underrepresented in the literature. By addressing the knowledge gap in the vegetation dynamics of Juncus roemerianus, our project contributes new scientific insights that are directly relevant to the ecosystems MDMR is charged with protecting.

16. Estimated number of years to completion:

3

17. Estimated Completion Date:

12/31/2028

18. Prioritize if your agency has submitted multiple projects:

NA

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BUDGET

Category	Total
Salaries	
Travel	
Architecture & Engineering	
Legal	
Consulting	
Construction	
Site Work	
Equipment	
Indirects	
Other	
Total	0

Attachments

1. gomesa_wu.pdf

☒ I hereby certify under penalty of perjury that all information contained in this application packet is true and correct. I have not knowingly or intentionally provided any false information. I understand that a false statement on this application may be grounds for rejection of my application or termination of the award. In addition, a false statement may be punishable under applicable state or federal laws, which may also result in a fine and/or imprisonment.

☒ I certify that the above referenced agency / entity has given me the authority to submit this application.

Name	Phone	Date
Wei Wu	228-818-8855	06/20/2025

Lead Project
Lead PI: Wei Wu
Co-PIs:
Proposal Title:)ls and advancing understanding of tipping points in coastal wetlands
Agency: MDMR GOMESA
Start Date: 1/1/2026
End Date: 12/31/2028

		Year 1				Year 2				Year 3				CUMMULATIVE	
		Agency		USM/MSU		Agency		USM/MSU		Agency		USM/MSU		Agency	USM
SALARY (SALARY)	Monthly Pay Rate	# of Mos	$	# of Mos	$	# of Mos	$	# of Mos	$	# of Mos	$	# of Mos	$	**$**	**$**
Wei Wu	9519.555556	1	9,520			1	9,710			1	9,904			29,134	**0**
														0	**0**
			0				0				0			0	**0**
			0				0				0			0	**0**
COA PhD Student	2375	12	28,500			12	28,500			6	14,250			71,250	**0**
COA Graduate Student	2100	12	25,200			12	25,200			6	12,600			63,000	**0**
Undergraduate student (1 student)			6,600				5,280				5,280			17,160	
	Subtotal		**69,820**				**68,690**				**42,034**			**180,544**	**0**
														0	
FRINGE (FRINGE) *Hyperlinked to USM fringe calculator														0	
Wei Wu	33.3411%		3,174				3,237				3,302			9,713	**0**
			0				0				0			0	**0**
			0				0				0			0	**0**
COA Post Doc Student	5.0053%		1,427				1,427				713			3,567	**0**
COA Graduate Student	5.5690%		1,403				1,403				702			3,508	**0**
COA Undergraduate students	1.0000%		66				53				53			172	
	Subtotal		**6,070**				**6,120**				**4,770**			**16,960**	**0**
														0	
TOTAL PERSONNEL			**75,890**				**74,810**				**46,804**			**197,504**	**0**
														0	
COMMODITIES (COMMOD)			**4,000**				**4,000**				**2,000**			**10,000**	**0**
Field and lab supplies			4,000				4,000				2,000			10,000	
COMMUNICATIONS (COMCAT)			**50**				**50**				3,050			**3,150**	**0**
Mailing			50				50				50			150	
Publications			0				0				3,000			3,000	
CONTRACTUAL SERVICES (OTCSVC)			**0**				**0**				**0**			**0**	**0**
														0	
PROFESSIONAL FEES (PROFES)			**0**				**0**				**0**			**0**	**0**
														0	
TRAVEL (TRAVEL)			**1,177**				**3,578**				**4,267**			**9,023**	**0**
Travel to three study sites			1,177				3,578				4,267			9,023	
EQUIPMENT (EQUIP) (>$5,000)			**0**				**0**				**0**			**0**	**0**
														0	
PARTICIPANT COSTS (PARTIC)			**0**				**0**				**0**			**0**	**0**
Meal coffee pamphlat sticking boards at competency group meetings														0	
RENTS (RENTS) **- Boat time**			**6,600**				**6,000**				**600**			**13,200**	**0**
$400 (including boat and captain) per day for 1 day														0	
SUBCONTRACTS (SUBCON) (F&A charged on first $25K/sub)			**0**				**0**				**0**			**0**	**0**
Sub A - Mississippi State														0	**0**
Sub B (add total sub amount; need separate detailed budget)														0	**0**
Sub C (add total sub amount; need separate detailed budget)														0	**0**
														0	
TUITION (SCHOL)			**0**				**0**				**0**			**0**	**0**
(AY23-24: $11,095 (in-state) + 5% increase/yr; add $2,336 for OOS, if needed)														**0**	
TOTAL DIRECT COSTS			**87,717**				**88,438**				**56,721**			**232,876**	**0**
														0	
MTDC			**81,117**			**0**	**82,438**			**0**	**56,121**			**219,676**	**0**
														0	
F&A (INDIRT) **MTDC**	Rate* =	50%	**40,559**			50%	**41,219**			50%	**28,061**			**109,839**	**0**
	*Adjust % as needed													**0**	
TOTAL PROJECTS COSTS			**128,276**				**129,657**				**84,782**			**342,715**	**0**

Budget Narratives - The University of Southern Mississippi

Salary ($180,544)

Principal Investigators 1-month summer salary for PI in each year is requested. We assume a 2% salary increase in Year 2 and 3 to account for cost-of-living adjustments. PI will oversee every aspect of the proposed project, including field trips, lab work, spatial analysis, modeling, and reporting results to MDMR.

Graduate Research Assistants 12-month salary for one PhD and one MS student is requested to cover their research assistantship during the duration of their graduate studies (Year 1-3 for PhD student and Year 1-2 for MS student). The students will be mentored by PI to help conduct the research activities and complete dissertations/theses. The student will contribute to disseminating the research products.

Undergraduate assistant A 5-month salary is requested each year for one undergraduate student assistant, paid at $15 per hour, to support graduate students with field and lab work.

Since this is a field-intensive research project, two graduate students and one undergraduate intern are essential.

Fringe Benefits ($16,960)

Fringe benefits are 33.34% for Wu, 5.01% for PhD student, 5.57% for graduate student, and 1% for a undergraduate student.

Commodities ($10,000)

Year 1 and Year 2: We request field, and lab supplies to measure vegetation and soil properties in coastal wetlands in order to develop a landscape model that can predict coastal wetland loss and landward migration.

Year 3: We request funds to purchase a computer and backup hard drives to support spatial analysis and modeling that mainly occur in Year 3.

Communication ($3,150)

We request $50 each year to cover the cost of mailings of documents and data. We request $3,000 to publish papers with open access that can reach a wide audience.

Travel ($9,023)

We request funds to cover the travel to Grand Bay NERR, Pascagoula Bay, and Graveline Bay to conduct field work (11 days in Year 1, 10 days in Year 2 and 1 day in Year 3). The extra one day in Year 1 is used to determine study sites. The 1-day in Year 2 is to collect auxiliary data to support model refinement and scenario analysis. In Year 2, we request $2,500 for a conference for the PI. In Year 3, we request $4,000 to support PI and student's travel to conference to disseminate research results.

In detail,

Year 1: $0.7/mile*60 miles/trip*11 trips (Grand Bay NERR) + $0.7/mile*60 miles/trip*11 trips (Pascagoula Bay) + $0.7/mile*22 miles/trip*11 trips (Graveline Bay) + $0.7/mile*60 miles/trip*2 trips (biannual meetings with resource managers at MDMR and Grand Bay NERR) = $1,177

Year 2: $0.7/mile*60 miles/trip*10 trips (Grand Bay NERR) + $0.7/mile*60 miles/trip*10 trips (Pascagoula Bay) + $0.7/mile*22 miles/trip*10 trips (Graveline Bay) + $0.7/mile*60 miles/trip*2 trips (biannual meetings with resource managers at MDMR and Grand Bay NERR) + $2,500 (conference: $1,100 hotel + $700 registration fees + $400 air ticket + $200 Per diem + $ 100 airport parking) = $3,578

Year 3: $0.7/mile*60 miles/trip*1 trip (Grand Bay NERR) + $0.7/mile*60 miles/trip*1 trip (Pascagoula Bay) + $0.7/mile*22 miles/trip*1 trip (Graveline Bay) + $0.7/mile*60 miles/trip*4

trips (quarterly meetings with resource managers at MDMR and Grand Bay NERR) + $4,000 (conference for two persons: per person: $800 hotel + $500 registration fees + $400 air ticket + $200 Per diem + $ 100 airport parking) = $4,267.

Boat Time ($13,200)

We will use jon boat at the PI's lab to access field sites. The boat operates at $200 per day.

Total Direct Costs ($232,876)

This includes USM personnel salary and fringe, commodities, travel, communication, boat rental, and subawards.

Indirect Costs ($109,839) The indirect cost is 50% of direct cost – boat rental.

Total Costs of this three-year proposed project ($342,715)

Grand Bay National Estuarine Research Reserve
6005 Bayou Heron Road · Moss Point, MS 39562 · (228) 475-7047 · http://grandbaynerr.org

June 17, 2025

Wei Wu
Professor, School of Ocean Science & Engineering
The University of Southern Mississippi
703 East Beach Drive, Ocean Springs MS 39564

Dear Wei:
I am pleased to offer this letter of support for your proposal entitled *"Developing model-based decision support tools and advancing understanding of tipping points in coastal wetlands"* submitted to the GOMESA Program for Fiscal Year 2026. As you know, the long-term persistence of coastal marshes is increasingly uncertain due to a variety of threats. It is therefore critical that we invest in efforts to predict the impacts of sea-level rise on vegetation communities and ecological processes, particularly through modeling marsh loss driven by erosion and inundation, as well as the potential for upland marsh migration.

The Grand Bay NERR has implemented a land management strategy and are actively pursuing the acquisition of upland areas to support marsh migration and protect the essential ecological functions these habitats provide. We are also interested in gaining a deeper understanding of how prescribed fire influences salt marsh migration, as fire is a critical tool for maintaining the pine savanna ecosystems within the Reserve. Additionally, we have constructed living shorelines and would like to evaluate their role in enhancing the resilience of salt marshes in the short- and long term. The tools proposed in your project could enhance our ability to plan and manage our Reserve. They would provide a stronger scientific foundation for decision-making and help us better understand the drivers of marsh loss and migration.

To support the success of this project and ensure effective dissemination of its research products, we will provide access to relevant Wetlands and Water Levels data and offer scientific insights and logistical support for fieldwork. We wish you the best with the proposal and look forward to hearing positive news soon.

Sincerely,

Jonathan Pitchford, Ph.D.
Assistant Extension Professor | *Mississippi State University*
Stewardship Coordinator | *Grand Bay National Estuarine Research Reserve* grandbaynerr.org
6005 Bayou Heron Road | Moss Point, MS 39562
Office: 228-523-4009| Fax: 228-475-8097