PROJECT SUMMARY

1. Title of Project

Evaluation and Monitoring of Marine Mammal Health in the Mississippi Sound

2. Location of Project

Mississippi State University (MSU) Global Center for Aquatic Heath and Food Security located at the College of Veterinary Medicine in Starkville, and MSU Gulf Coast Aquatic Health Laboratory on the MS Gulf Coast

3. Requesting Organization:

Mississippi State University

4. Requesting Agency Representative

a. Name:

Kacey Strickland, Assistant VP & Executive Director of Research, Office of Sponsored Projects

b. Phone:

662-325-7404

d. Email:

aor@osp.msstate.edu

c. Address:

301 Research Blvd,

PO Box 6156, Mississippi State, MS 39762

Starkville Mississippi

5. Funding Requested:

$1721529

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

$1721529

9. Provide Brief Project Description/Overview:

This proposed project will assess environmental factors affecting the health of dolphins in the Mississippi Sound (MSS). We aim to examine the effects of freshwater (FW) from Mississippi River diversion compared to native Mississippi rivers draining into the MSS on mortalities of bottlenose dolphins. 1. We will modify an existing hydrodynamic model to simulate water quality parameters individual dolphins experienced in their habitat during the time before death. 2. We will assess the influence of river sources on MSS dolphins. The isotopic landscape of the MSS and river systems that contribute notable flow to the MSS will be analyzed, and then we will evaluate dolphins with stable isotope analysis (SIA) to determine if FW exposure occurred and the source of the exposure. This information will be useful for evaluating the environment because water quality not only affects dolphins but also the entire food web. 3. We will investigate the source of environmental toxicants we previously identified in MSS dolphins through analysis of river sources and prey species. Toxicant levels of MSS river sources will be investigated, as well as levels in prey species of dolphins in the MSS. From these investigations, we seek to better understand toxicant presence throughout the food web and their accumulation in the environment. 4. This project will assess whether bacteria we previously identified in dolphin freshwater lesions (Streptococcus and Aeromonas) are statistically associated with dolphin skin lesions using microbiological and histological techniques. These bacteria were identified in the microbiome of dolphins stranded during the 2019 UME (Unusual Mortality Event). These findings are particularly important for delineating pathogenesis of skin lesions in dolphins. 5. This project will expand on prior research to characterize the genetic diversity of dolphins in the MSS and investigate potential links between genetic subgroups and environmental exposure, including FW influence, toxicant exposure, and skin lesion prevalence. Genetic data from dolphins that died after 2021 will be added to the existing dataset, and analyses will be conducted to evaluate population structure, gene-environment interactions, and temporal trends. We will integrate genetic findings with environmental, toxicological, and pathological data using an established epidemiological database to assess whether certain genotypes are more vulnerable to specific environmental stressors.

10. LIST Project Goals/Objectives:

1. Hydrodynamic Modeling: The drifting nature of dolphin carcasses before stranding makes determining the precise location and environmental conditions at the time of death challenging. To address this, the objectives here are 1a) continue updating and refining a hydrodynamic/water quality/particle tracking model of the MSS (Shahidzadehasadi et al., 2024) and update it to run through 2025, 1b) simulate trajectories of dolphin carcasses, 1c) delineate habitat ranges for dolphin genetic subpopulations, 1d) ascertain the salinity, temperature, dissolved oxygen, and riverine flow levels experienced by dolphins leading up to their deaths. Simulations will be run for approximately 60 recently dead dolphin carcasses whose genetic codes have been identified (Arick et al., 2025). The model will be used to identify water quality conditions (including salinity, temperature, dissolved oxygen, and riverine flow) for the habitat range of each dolphin in the time leading up to death. 2. Stable Isotope Analysis (SIA): FW exposure is a commonly recognized threat to bottlenose dolphins in the MS Sound (MSS) and many areas around the world. We will apply SIA tools using sulfur, oxygen, and/or carbon isotopes to assess FW exposure in stranded bottlenose dolphins to: 2a) determine if there is evidence of FW exposure among dolphins stranded in the MSS, 2b) determine if FW exposure is increasing over time, 2c) work to identify the source of FW exposure by assessing the "isotopic landscape" of coastal rivers and the Mississippi River, and 2d) determine if and how dolphin tissue decomposition affects isotopic ratios. 3. Investigate the source of environmental contaminants identified by Landrau-Giovannetti et al. (2024) by 3a) analyzing water from collected river samples for persistent organic pollutant (POPs) and heavy metals, 3b) analyzing microplastics in bottlenose dolphin tissue for carriage of toxicants, and 3c) analyzing water and tissue of prey fish in the MS Sound to determine if toxicants are originating from lower trophic levels.4. Determine whether detection of Streptococcus and Aeromonas is significantly associated with FW lesions. Both pathogens were detected in the microbiome of dolphin FW skin lesions. PCR assays for Streptococcus and Aeromonas will be developed and utilized to determine association with FW lesions. Presence of the pathogens in lesions will be determined through in situ hybridization. 5. Determine if the population structure of MSS dolphins are shifting over time by extending our genetic analysis (Arick et al., 2025) into recent years. Temporal and geographical analysis will be conducted to evaluate dolphin populations, and integration of genetic subgroup data into our epidemiology/pathology database will enable investigation of associations with toxicants, water sources, and pathogens.

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**

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

The MSS is a critical economic and natural resource for the State of Mississippi. Common bottlenose dolphins are not only an important natural resource, but as apex predators, their health reflects the environmental health of the MSS. Project goals address testing water and tissues of dolphins to delineate the impact of water conditions (including freshwater exposure from different river sources), environmental contaminants, and infectious agents on the health of these important animals. Findings from this project will inform MDMR for making important management decisions to mitigate threats to health of fish, wildlife, and natural resources in the MSS.

☐ **(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:

Project Timetable/Milestones:
This is a 2-year project. Data collection, analysis, and reporting will be conducted in year 1, and data collection, analysis, reporting, and publication preparation will be done in year 2.

Water quality. By the end of this project, we aim to have a comprehensive understanding of the effects of water quality on mortalities of distinct genetic subpopulations of dolphins in the Mississippi Sound (MSS). In year 1, an existing 3D hydrodynamic model (EFDC+ 11.2) developed by Armandei et al (2021) will be refined and extended into 2021-25 through mapping of additional code 2 dolphins and by adding water quality data into the model. In year 2, the refined model will be used to map conditions individual dolphins experienced in the days and weeks before death.

Stable isotope analysis. This project will investigate river source effects on dolphins, particularly those with freshwater (FW) lesions. Samples of water, primary poducers, and dolphin tissues will be collected in year 1 for analysis. Stable isotope analysis will begin in year 1 and continue into year 2, followed by data analysis to determine impact of FW exposure among stranded dolphins, assess the relative exposure of MSS dolphins to different river systems, and determine whether tissue decomposition affects isotopic ratios.

Bacterial pathogens. We will investigate whether there is an association of Streptococcus or Aeromonas with FW lesions by PCR analysis and histological techniques. In year 1, PCR methods will be developed, and PCR analysis of selected tissues will be done. In situ hybridization to detect the pathogens in lesions will be done in year 2.

Toxicant analysis. Work previously performed described the presence of persistent organic pollutants (POPs) and heavy metals in dolphin tissues from the MSS (Landrau Giovannetti et al., 2024). Water samples will be the same as those used for stable isotope analysis and will be collected in year 1. Prey fish samples will also be collected in year 1. Toxicant analysis will be conducted after sample collection in year 1 and completed in year 2. Methods for isolation of microplastics will be developed in year 1. In year 2, microplastics will be analyzed for carrying toxicants such as perfluorooctane sulfonate, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and the polycyclic aromatic hydrocarbon naphthalene.

Dolphin genetics. Genetic analysis of MSS dolphins will be extended into 2022-2025 to enable analysis of changes in MSS subpopulations over time. Sample selection and genetic analysis will be conducted in year 1. In year 2, associations between genetic subgroups and water quality conditions, river water exposure, toxicant exposure, and bacterial pathogens will be analyzed. By the end of this project, we aim to generate results that will inform MDMR on their conservation and management of MSS dolphins and their habitat.

13. Project Timing

Short-term (3 year or less)

APPLICATION SUMMARY QUESTIONNAIRE

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

Group 1:

Completed

Group 2:

Paid for

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.?

The Mississippi River drains 41% of the contiguous U.S. Industrial activities and agriculture potentially release environmental toxicants from the Mississippi River drainage basin into the Mississippi Sound (MSS) and may be responsible for toxicants we detected in bottlenose dolphin tissues (Landrau-Giovannetti et al., 2024). The analyses outlined in this project proposal will provide important information about the health of Mississippi's marine resources and potential sources of contamination.

Specifically, this project aims to differentiate effects of the Mississippi River compared to native Mississippi rivers on the health of dolphins in the MSS. It will investigate potential sources of environmental toxicants by analyzing water, dolphin tissues, and prey fish from the MSS. This project looks to determine the river source effects on the MSS resident dolphin population through the use of stable isotope analysis. These investigations will reveal the level and source of freshwater (FW) and its effects on MSS dolphins, including their microbiome. By extending genetic analysis into most recent years from work previously performed (Arick II, 2025), this project will help determine changes in the MSS resident dolphin populations over time.

These analyses would be beneficial to Mississippi and MDMR by providing up-to-date assessments on our resident dolphin population and a scientific basis for MDMR management of the MSS and adjacent waters. In particular, the effects of the MSS environment and river sources on health of resident MSS dolphins will be assessed. This data made available to MDMR will support management decisions and help MDMR enhance, protect, and conserve marine life and their habitats to support sustainable use of Mississippi's marine resources for present and future generations.

16. Estimated number of years to completion:

2

17. Estimated Completion Date:

September 30, 2028

18. Prioritize if your agency has submitted multiple projects:

N/A

BUDGET

Category	Total
Salaries	561250
Travel	45880
Architecture & Engineering	
Legal	
Consulting	
Construction	
Site Work	
Equipment	
Indirects	463550
Other	650849
Total	1721529

Attachments

1. signedgomesa-form-fy2026.pdf
2. projectnarrative.pdf
3. gomesa-budget.pdf
4. budgetjustification.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
Kacey Strickland	662-325-7404	06/30/0025

Title: Evaluation and Monitoring of Marine Mammal Health in the MS Sound
Date 10/1/2026-9/30/2028
Salaries and Wages

	Base Salary	Level of Effort	YEAR 1	YEAR 2
Dr. Beth Peterman, PI	$74,620	40.00%	$29,848	$30,743
Dr. Mark Lawrence, CoPI	$239,618	2.00%	$4,792	$4,936
Dr. Stephen Reichley, CoPI	$173,208	3.00%	$5,196	$5,352
Dr. Attila Karsi CoPI *9 month	$139,828	5.00%	$6,991	$7,201
Dr. Barb Kaplan, CoPI *9 month	$136,472	10.00%	$13,647	$14,057
Dr. Kaylin McNulty, CoPI	$142,137	5.00%	$7,107	$7,320
Dr. Isaac Jumper, CoPI	$133,250	3.00%	$3,998	$4,117
Dr. Sandra Correa CoPI *9 month	$95,760	11.11%	$10,639	$10,958
Research Associate - Starkville - Jill Hudnall	$43,888	50.00%	$21,944	$22,602
Research Associate - Gulfport - Ryanne Murray	$43,888	50.00%	$21,944	$22,602
Post-Doctoral Research Associate (Basant Gomaa, 25%)	$48,000	25.00%	$12,000	$12,360
Research Associate (Tony Arick, 2%)	$91,155	2.00%	$1,823	$1,878
Graduate student - stable isotope analysis	$23,000	100.00%	$23,000	$23,000
Graduate student - microplastics	$26,000	100.00%	$26,000	$26,000
Graduate student - histopathology	$26,000	100.00%	$26,000	$26,000
Student worker	$6,240	100.00%	$6,240	$6,240
Intermittent worker	$5,760	100.00%	$5,760	$0
Salary Total			**$226,929**	**$225,366**
Fringe Benefits - 12 month		**41.19%**	$ 44,754	$ 46,096
Fringe Benefits - 9 month		**26.17%**	$ 8,185	$ 8,431
Student Fringe Benefits		0.62%	$ 504	$ 504
intermittent worker Fringe benefits		8.35%	$ 481	$ -
Fringe Benefits Total			$ 53,924	$ 55,031
Total Salaries, Wages, and Fringe Benefits			**$280,853**	**$280,397**

Nonexpendable Equipment

Total Nonexpendable Equipment			$ -	

Travel

CVM faculty/staff travel to pertinent conferences to present/represent GOMESA			$ 15,000	$ 15,000
CVM Travel to Gulfcoast for sample collection			$ 5,000	$ 5,000
CFR faculty/staff travel to pertinent conferences to present/represent GOMESA			$ -	$ 3,600
CFR Travel to Gulfcoast for sample collection			$ 2,280	$ -
Total Travel			**$ 22,280**	**$ 23,600**

Materials and Supplies

Microbiome - microbiology, sequencing reagents, PCR supplies			$ 6,000	$ 6,000
histopathology-In Situ Hybridization			$ 6,000	$ 6,000
CVM General lab supplies			$ 6,500	$ 6,500
Toxicology			$ 6,000	$ 6,000
gDNA Kits			$ 6,000	$ 6,000
Bioanalyzer DNA Kit			$ 4,000	$ 4,000
microplastics supplies			$ 6,000	$ 6,000
CFR General lab supplies			$ 1,000	
Gasoline for MSU boat			$ 300	
Gasoline for MSU lab truck			$ 1,000	
Total Materials and Supplies			**$ 42,800**	**$ 40,500**

Contractual Services

IGBB Service Center (DNA sequencing) 250 samples at $565.18/sample			$ 70,648	$ 70,648
Microplastic analysis (200 samples at $50/sample)			$ 5,000	$ 5,000
Toxicology analysis (RCRA metals + Aluminum) (200 samples analyzed at $100/sample)			$ 10,000	$ 10,000
Toxicology analysis (polychlorinated Biphenyls Dutch 7 + Naphthalene) (200 samples at $250/sample)			$ 25,000	$ 25,000
Toxicology analysis (persistent organic pollutants) (200 samples at $100/sample)			$ 10,000	$ 10,000
Stable isotope analysis			$ 12,900	$ 12,900
Conference registration fees, (PI, graduate students), one conference per year, project year 2 (2 people) (Cost per person: $600 registration)			$ -	$ 1,200
Total Contractual Services			**$ 133,548**	**$ 134,748**

Subawards

Auburn University			$ 132,736	$ 61,280
Total Subawards			**$ 132,736**	**$ 61,280**

Other

Graduate student tuition		100.00%	$ 44,910	$ 47,169
GRA Insurance			$ 6,417	$ 6,741
Total Other			**$ 51,327**	**$ 53,910**

Total Direct Costs			**$663,544**	**$594,435**
Modified Total Direct Costs (MTDC)			**$ 510,898**	**$ 485,986**
Total Indirect Costs		46.50%	**$ 237,567**	**$ 225,983**
Total Project Costs			**$ 901,111**	**$ 820,418**

Budget Justification

Title: Evaluation and Monitoring of Marine Mammal Health in the Mississippi Sound

Mississippi State University Global Center for Aquatic Health and Food Security

SALARIES & WAGES: $452,295

Funding is requested to support the following personnel's responsible for implementing and managing all aspects of the project:

Beth Peterman (PI and project manager, 40% LOE) will oversee the project and coordinate sample collection. The total salary requested for Dr. Peterman is $60,591.

Mark Lawrence (Co-PI, 2% effort) will oversee microbiome analyses and will be assisted by **Basant Gomaa** (post-doc, 25% effort). The total salary requested for Dr. Lawrence and Dr. Gomaa are $9,728 and $24,360 respectively.

Stephen Reichley (Co-PI, 3% effort) will oversee hydrodynamic modeling. The total salary requested for Dr. Reichley is $10,548.

Dr. Isaac Jumper (Co-PI, 3% effort) will assist with epidemiological analysis. The total salary requested for Dr. Jumper is $8,115 for the project.

Dr. Attila Karsi (Co-PI, 5% effort, 9 month) will oversee genetic analyses of dolphins and sea turtles and will be assisted by **Tony Arick** (2% effort). The total salary requested for Dr. Karsi and Tony are $14,192 and $3,701 respectively.

Dr. Barbara Kaplan (Co-PI, 10% effort, 9 month) will oversee toxicology and microplastics analysis. The total salary requested for Dr. Kaplan is $27,704.

Dr. Kaylin McNulty (Co-PI, 5% effort) will conduct histopathological analysis. **Jill Hudnall** (research associate in Starkville, MS, 50% effort) and **Ryanne Murray** (research associate in Gautier, MS, 50% effort) will assist with sample collection, database maintenance, sample and data analysis. The total salary requested for Dr. McNulty, Jill, and Ryanne are $14,427, $44,546, and $44,546 respectively.

Dr. Sandra Correa (Co-PI, 11.11% effort) will oversee, participate in and coordinate sample analysis for stable isotope analysis. Sample analysis will be supported by an **intermittent student worker** in year 1 for a total of $5,760 and an **undergraduate student worker** in year 1 and 2 (520 hours per year at $12.00 per hour) for $12,480. The total salary requested for Dr. Corea for the project is $21,597.

Three **graduate students** will be hired to do stable isotope analysis, microplastic analysis, and histopathology analysis. Two graduate students at MSU GCAHFS will be hired at the rate of $26,000 per year and one graduate student will be hired at MSU CFR at the rate of $23,000 per year. For a total of $150,000.

FRINGE BENEFITS: $108,955

Fringe benefits are calculated at 41.19% for 12-month benefits eligible employees, 26.17% for 9 month benefits eligible employees, 0.62% for students, and 8.35% for intermittent workers.

EQUIPMENT: $0

Funds are not requested for equipment.

TRAVEL: $45,880

Travel funds will be used for travel to the MS Gulf Coast from Starkville, MS, or vice versa, for collection of samples including water, fish, and tissues. Travel funds will also be used for travel to conferences such as Gulf of Mexico Conference (GOMCON), International Association of Aquatic Animal Medicine (IAAAM), the annual meeting of the American College of Veterinary Pathologists (ACVP), and/or the annual meeting of the Society of Toxicology to share findings.

MATERIALS & SUPPLIES: $83,300

Materials and supplies are requested for microbiome analysis including microbiology, sequencing reagents, PCR supplies at $6,000 in year 1 and year 2 for a total of $12,000. Histopathology supplies including slides, stains, and antibodies for Situ hybridization are requested for $6,000 in year 1 and year 2. General lab supplies funds are requested for material and supplies including gloves, lab coats, lab books, etc. at $6,500 in year 1 and year 2 for a total of $13,000. Toxicology supplies are requested for reagents and materials for toxicological analysis including water bottles, coolers for transport, etc. at $6,000 in year 1 and year 2 for a total of $12,000. gDNA kit funds are requested for isolation of DNA for $6,000 in year 1 and year 2 and Bioanalyzer DNA kit supplies are requested for $4,000 in year 1 and year 2. Funds are requested for microplastics research materials and supplies for analyzing samples for microplastic content for $6,000 for year 1 and year 2 for a total of $12,000. Funds are requested for gasoline for boat access to the river during sampling at 4 rivers (15 gallons/trip, $5/gallon) for a total of $300. Funds are requested for gasoline for the lab truck to conduct sampling at 4 rivers (750 miles per trip, $5/gallon, consumption rate of 15 miles/gallon) for a total of $1000.

CONTRACTUAL: $268,296

Contractual funds will be used for DNA sequencing (250 samples at $565.18 per sample), microplastic analysis (200 samples at $50/sample), toxicology analysis (200 samples at $100/sample for RCRA metals + Aluminum; 200 samples at $250/sample for polychlorinated Biphenyls Dutch 7 + Naphthalene; 200 samples at $100/sample for persistent organic pollutants), and stable isotope analysis ($25 per sample sulfur isotopes. $12 per sample carbon isotopes. $35 per sample oxygen & deuterium isotopes from organic matter. $15 per sample oxygen & deuterium isotopes from water. Number of samples: 990 total Dolphin tissue: 750 samples total: 150 samples at $25 with 2 replicates; 150 samples at $35 with 2 replicates; 150 sample at $12 with 1 replicate. Water: 120 samples total: 60 samples at $25 with 1 replicate; 60 samples at $15 with 1 replicate). Contractual funds will also be used for conference registration fees for PIs and/or graduate students.

TUITION: $92,079

Tuition costs are requested for $44,910 for year 1 and $47,169 for year 2 for three students. That calculates to $1,232 (FY27) per month for 9 months and $1,294 (FY28) for 3 months for year 1. Year 2 is calculated at 9 months at $1,294 (FY28) per month and 3 months at $1,359 (FY29) for each student.

INSURANCE: $13,158

Insurance costs are requested for year 1 at the rate of $176 (FY27) for 9 months per month and $185 (FY28) for 3 months. In year 2 at the rate of $185 (FY28) per month for 9 months and $194 (FY29) for 3 months for each student. Total insurance requested for year 1 is $6,417and year 2 is $6,741.

SUBCONTRACT: $194,016

A subcontract will be issued to Auburn University to conduct Hydrodynamic Modeling: The drifting nature of dolphin carcasses before stranding makes determining the precise location and environmental conditions at the time of death challenging. To address this, the objectives here are 1a) continue updating and refining a hydrodynamic/water quality/particle tracking model of the MSS (Shahidzadehasadi et al., 2024) and update it to run through 2023, 1b) simulate trajectories of dolphin carcasses, 1c) delineate habitat ranges for dolphin genetic subpopulations, 1d) ascertain the salinity, temperature, dissolved oxygen, and riverine flow levels experienced by dolphins leading up to their deaths. Simulations will be run for approximately 60 recently dead (code 2) dolphin carcasses whose genetic codes have been identified (Arick et al. 2025). The model will be used to identify water quality conditions (including salinity, temperature, dissolved oxygen, and riverine flow) for the habitat range of each dolphin in the time leading up to death. Funds requested in year 1 are $132,736 and year 2 are $61,280.

Total Direct Costs: $1,257,979

Modified Total Direct Costs: $996,884

Total indirect costs: $463,550

Indirect costs are calculated at 46.5% of the modified total direct costs.

Total Costs: $1,721,529

Title: Evaluation and Monitoring of Marine Mammal Health in the Mississippi Sound

Beth Peterman, Mark L. Lawrence, Stephen R. Reichley, Attila Karsi, Barbara Kaplan, Kaylin McNulty, Isaac Jumper, and Sandra Correa

Brief project Description/Overview:

This proposed project will assess environmental factors affecting the health of dolphins in the Mississippi Sound (MSS). We aim to examine the effects of freshwater from Mississippi River diversion compared to native Mississippi rivers draining into the MSS on mortalities of bottlenose dolphins. ***First***, *we will modify an existing hydrodynamic model* (Shahidzadehasadi et al., 2024) *to simulate water quality parameters individual dolphins experienced in their habitat during the time before death.* ***Second***, *we will assess the influence of river sources on MSS dolphins*. The isotopic landscape of the MSS and river systems that contribute notable flow to the MSS will be analyzed, and then we will evaluate dolphins with stable isotope analysis (SIA) to determine if freshwater (FW) exposure occurred and the source of the exposure. This information will be useful for evaluating the environment because water quality not only affects dolphins but also the entire food web. ***Third***, *we will investigate the source of environmental toxicants we previously identified in MSS dolphins* (Landrau Giovannetti et al., 2025; Landrau Giovannetti et al., 2024) through analysis of river sources and prey species. Toxicant levels of MSS river sources will be investigated, as well as toxicant levels in prey species of dolphins in the MSS. From these investigations, we seek to better understand toxicant presence throughout the food web and their accumulation in the environment. ***Fourth***, *this project will assess whether bacteria we previously identified in dolphin freshwater lesions (Streptococcus and Aeromonas) are statistically associated with dolphin skin lesions* using microbiological and histological techniques. These bacteria were identified in the microbiome of dolphins stranded during the 2019 UME (Unusual Mortality Event). These findings are particularly important for delineating pathogenesis of skin lesions in dolphins. ***Fifth***, *this project will expand on prior research to characterize the genetic diversity of dolphins in the MSS and investigate potential links between genetic subgroups and environmental exposure, including freshwater influence, toxicant exposure, and skin lesion prevalence*. Genetic data from dolphins that died after 2021 will be added to the existing dataset (Arick et al., 2025), and analyses will be conducted to evaluate population structure, gene-environment interactions, and temporal trends. We will integrate genetic findings with environmental, toxicological, and pathological data using an established epidemiological database to assess whether certain genotypes are more vulnerable to specific environmental stressors. In summary, this project will utilize the above-mentioned analyses to improve our understanding of factors affecting the health of dolphins in the MS Sound.

List Project Goal/Objectives:

1. Hydrodynamic Modeling: The drifting nature of dolphin carcasses before stranding makes determining the precise location and environmental conditions at the time of death challenging. To address this, the objectives here are 1a) continue updating and refining a hydrodynamic/water quality/particle tracking model of the MSS (Shahidzadehasadi et al., 2024) and update it to run through 2025, 1b) simulate trajectories of dolphin carcasses, 1c) delineate habitat ranges for

dolphin genetic subpopulations, 1d) ascertain the salinity, temperature, dissolved oxygen, and riverine flow levels experienced by dolphins leading up to their deaths. Simulations will be run for approximately 60 recently dead dolphin carcasses whose genetic codes have been identified (Arick et al., 2025). The model will be used to identify water quality conditions (including salinity, temperature, dissolved oxygen, and riverine flow) for the habitat range of each dolphin in the time leading up to death.

2. Stable Isotope Analysis (SIA): FW exposure is a commonly recognized threat to bottlenose dolphins in the MS Sound (MSS) and many areas around the world. We will apply SIA tools using sulfur, oxygen, and/or carbon isotopes to assess FW exposure in stranded bottlenose dolphins to: 2a) determine if there is evidence of FW exposure among dolphins stranded in the MSS, 2b) determine if FW exposure is increasing over time, 2c) work to identify the source of FW exposure by assessing the "isotopic landscape" of coastal rivers and the Mississippi River, and 2d) determine if and how dolphin tissue decomposition affects isotopic ratios.

3. Investigate the source of environmental contaminants identified by Landrau-Giovannetti et al. (2024) by 3a) analyzing water from collected river samples for persistent organic pollutant (POPs) and heavy metals, 3b) analyzing microplastics in bottlenose dolphin tissue for carriage of toxicants, and 3c) analyzing water and tissue of prey fish in the MS Sound to determine if toxicants are originating from lower trophic levels.

4. Determine whether detection of *Streptococcus* and *Aeromonas* is significantly associated with FW lesions. Both pathogens were detected in the microbiome of dolphin FW skin lesions. PCR assays for *Streptococcus* and *Aeromonas* will be developed and utilized to determine association with FW lesions. Presence of the pathogens in lesions will be determined through in situ hybridization.

5. Determine if the population structure of MSS dolphins are shifting over time by extending our genetic analysis (Arick et al., 2025) into recent years. Temporal and geographical analysis will be conducted to evaluate dolphin populations, and integration of genetic subgroup data into our epidemiology/pathology database will enable investigation of associations with toxicants, water sources, and pathogens.

Category B: Mitigation of damage to fish, wildlife or natural resources (650 characters)

The MSS is a critical economic and natural resource for the State of Mississippi. Common bottlenose dolphins are not only an important natural resource, but as apex predators, their health reflects the environmental health of the MSS. Project goals address testing water and tissues of dolphins to delineate the impact of water conditions (including freshwater exposure from different river sources), environmental contaminants, and infectious agents on the health of these important animals. Findings from this project will inform MDMR for making important management decisions to mitigate threats to health of fish, wildlife, and natural resources in the MSS.

Project Timetable/Milestones:

This is a 2-year project. Data collection, analysis, and reporting will be conducted in year 1, and data collection, analysis, reporting, and publication preparation will be done in year 2.

Water quality. By the end of this project, we aim to have a comprehensive understanding of the effects of water quality on mortalities of distinct genetic subpopulations of dolphins in the Mississippi Sound (MSS). In year 1, an existing 3D hydrodynamic model (EFDC+ 11.2) developed by Armandei et al (2021) will be refined and extended into 2021-25 through mapping of additional code 2 dolphins and by adding water quality data into the model. In year 2, the refined model will be used to map conditions individual dolphins experienced in the days and weeks before death.

Stable isotope analysis. This project will investigate river source effects on dolphins, particularly those with freshwater (FW) lesions. Samples of water, primary poducers, and dolphin tissues will be collected in year 1 for analysis. Stable isotope analysis will begin in year 1 and continue into year 2, followed by data analysis to determine impact of FW exposure among stranded dolphins, assess the relative exposure of MSS dolphins to different river systems, and determine whether tissue decomposition affects isotopic ratios.

Bacterial pathogens. We will investigate whether there is an association of *Streptococcus* or *Aeromonas* with FW lesions by PCR analysis and histological techniques. In year 1, PCR methods will be developed, and PCR analysis of selected tissues will be done. In situ hybridization to detect the pathogens in lesions will be done in year 2.

Toxicant analysis. Work previously performed described the presence of persistent organic pollutants (POPs) and heavy metals in dolphin tissues from the MSS (Landrau Giovannetti et al., 2024). Water samples will be the same as those used for stable isotope analysis and will be collected in year 1. Prey fish samples will also be collected in year 1. Toxicant analysis will be conducted after sample collection in year 1 and completed in year 2. Methods for isolation of microplastics will be developed in year 1. In year 2, microplastics will be analyzed for carrying toxicants such as perfluorooctane sulfonate, 2,3,7,8-tetrachlorodibenzo-p-dioxin, and the polycyclic aromatic hydrocarbon naphthalene.

Dolphin genetics. Genetic analysis of MSS dolphins will be extended into 2022-2025 to enable analysis of changes in MSS subpopulations over time. Sample selection and genetic analysis will be conducted in year 1. In year 2, associations between genetic subgroups and water quality conditions, river water exposure, toxicant exposure, and bacterial pathogens will be analyzed. By the end of this project, we aim to generate results that will inform MDMR on their conservation and management of MSS dolphins and their habitat.

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?

The Mississippi River drains 41% of the contiguous U.S. Industrial activities and agriculture potentially release environmental toxicants from the Mississippi River drainage basin into the

Mississippi Sound (MSS) and may be responsible for toxicants we detected in bottlenose dolphin tissues (Landrau-Giovannetti et al., 2024). The analyses outlined in this project proposal will provide important information about the health of Mississippi's marine resources and potential sources of contamination.

Specifically, this project aims to differentiate effects of the Mississippi River compared to native Mississippi rivers on the health of dolphins in the MSS. It will investigate potential sources of environmental toxicants by analyzing water, dolphin tissues, and prey fish from the MSS. This project looks to determine the river source effects on the MSS resident dolphin population through the use of stable isotope analysis. These investigations will reveal the level and source of freshwater (FW) and its effects on MSS dolphins, including their microbiome. By extending genetic analysis into most recent years from work previously performed (Arick II, 2025), this project will help determine changes in the MSS resident dolphin populations over time.

These analyses would be beneficial to Mississippi and MDMR by providing up-to-date assessments on our resident dolphin population and a scientific basis for MDMR management of the MSS and adjacent waters. In particular, the effects of the MSS environment and river sources on health of resident MSS dolphins will be assessed. This data made available to MDMR will support management decisions and help MDMR enhance, protect, and conserve marine life and their habitats to support sustainable use of Mississippi's marine resources for present and future generations.

References:

Arick II, M. A., O'Hara, T. M., Rosel, P. E., Litz, J. A., & Venn-Watson, S. (2025). *Genetic characterization and health correlates of common bottlenose dolphins in the Mississippi Sound, USA* [Manuscript in preparation].

Armandei, M., Shahidzadehasadi, H., & Suedel, B. (2021). *Hydrodynamic and water quality modeling of the Mississippi Sound using EFDC+*. U.S. Army Engineer Research and Development Center. https://doi.org/10.21079/11681/41938

Landrau-Giovannetti, N., Murray, R., Reichley, S., Moore, D., Madrigal, T., Brown, A., Meredith, A., Childers, C., Sparks, D., Solangi, M., & others. (2025). Tissue element levels and heavy metal burdens in bottlenose dolphins that stranded in the Mississippi Sound surrounding the 2019 unusual mortality event. *Toxics, 13*(6), 511. https://doi.org/10.3390/toxics13060511

Landrau-Giovannetti, N.*, Rogers, J., Murray, R., Reichley, S. R., Moore, D., Madrigal, T., Brown, A., et al. (2024). "Determination of PCB and PAH tissue levels in bottlenose dolphins that stranded in the Mississippi Sound before and after the unusual mortality event in 2019." *Science of the Total Environment*, 954, 176747.

Shahidzadehasadi, H., Armandei, M., & Suedel, B. (2024). *Advancements in 3D hydrodynamic modeling for environmental assessment in the northern Gulf of Mexico*. Environmental Modeling & Assessment. https://doi.org/10.1007/s10666-024-09876-x