



# **GULF OF MEXICO RESEARCH PLAN**

SUPPLEMENTAL DOCUMENT: First and Second Tier Gulf of Mexico Research Priorities Arranged Using the Framework in the National Ocean Research Priorities Plan



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Document designed by Melissa Schneider, Mississippi-Alabama Sea Grant Consortium

Map graphic on cover designed by Tanya Baker, Texas Sea Grant College Program

Cover photos:

Top left: Melissa Schneider/Mississippi-Alabama Sea Grant Consortium

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Top right: Texas Sea Grant

Bottom right: Marisol Amador/University of Florida/Institute of Food and Agricultural Sciences



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## **Gulf of Mexico Research Priorities Arranged by ORPP-defined Societal Themes and Research Priorities**

Gulf of Mexico research priorities are arranged by “Top Tier,” which are the research priorities that support the Gulf of Mexico high-priority topic areas included in the Gulf of Mexico Research Plan, and “Second Tier” priorities, which are the remaining Top 10 workshop priorities, supporting Top 11-20 workshop priorities, and survey comments that were not captured within a high-priority topic area. The priorities are arranged by ORPP theme and research priority.

### **ORPP Theme: Improving Ecosystem Health**

#### **Understand and predict the impact of natural and anthropogenic processes on ecosystems Ocean Research Priorities Plan Research Priority 14 (ORPP RP14)**

##### Top Tier Gulf of Mexico Priorities

- Predict the impacts of current building and permitting practices on freshwater inflow and examine the effects of human manipulation (e.g. upstream impoundments, causeways, placing processed water into confined areas) on the amount, timing, and type of freshwater inflows and their impacts on natural resources and the environment
- Analyze the role of freshwater input on coastal wetlands and habitat change over time to determine the hydrologic requirements of healthy marsh systems and quantify effects of sediment discharge reduction on erosion rates and habitat loss
- Examine the impacts of higher saline water and temperature change on water stratification, biodiversity, species composition and production, benthic communities, trophic interactions, fisheries, the range of native and non-native species, emergent coastal habitats, and sediment transport and shoreline erosion
- Evaluate the relationship of coastal development, land use, land cover, storm water and wastewater management on eutrophication, nutrient loading, water quality, and the environment
- Identify the relationships between nutrient loading, eutrophication, hypoxia, and harmful algal blooms; examine their impacts on ecosystem health, seagrasses, and higher trophic organisms; and determine the effects of freshwater diversion on hypoxia
- Model the impacts of non-point source pollution on coastal resources

##### Second Tier Gulf of Mexico Priorities

- Examine impacts of global climate change on local ecosystems, and design flexible ecosystem models to predict local impacts
- Determine the response of organisms and the emergence or prevalence of pathogens in response to changing levels of temperature, salinity, carbon dioxide, wind, and other climate-linked factors
- Examine Gulf of Mexico watershed systems in terms of evaluating current sediment, freshwater volume, and nutrient loads in these systems to better assess the potential for restoring critical areas and habitats
- Evaluate the total potential of Mississippi River restoration considering sediment, freshwater volume, nutrients, and optimal distribution of the Achafofaya and Mississippi Rivers.

#### **Apply understanding of natural and anthropogenic processes to develop socioeconomic assessments and models to evaluate the impact of multiple human uses on ecosystems (ORPP RP15)**

##### Second Tier Gulf of Mexico Priorities

- Identify social and economic drivers that influence how communities use their resources; examine why communities make different conservation decisions; and determine and catalog the

socioeconomic impacts and value of changing the level of protection (increasing or decreasing protection) and restoration of ecosystems at various scales and determine how this impacts resource users, communities, and the environment (including if habitat functions as expected)

- Identify the true costs and true benefits of future coastal development and include the economic impacts of climate change on maritime activities, oil and gas, fisheries, infrastructure, and tax base
- Predict the socioeconomic and ecological impacts of future coastal development and population growth in the coastal zone based on projections of future development and including an examination of the historic and prehistoric human densities in the coastal zone
- Examine the balance between optimizing future coastal development while minimizing environmental impacts, maximizing quality of life, and maintaining public access
- Examine the economic, cultural, and intrinsic value of working waterfronts including economic, social, and environmental cost-benefit analyses of working waterfronts to compare with other waterfront uses
- Characterize Gulf of Mexico fishing communities using socioeconomic methods, and determine the economic feasibility of alternatives to wild harvest fisheries such as aquaculture
- Model economic impacts to fisheries production, recreational uses of the resources, and community resiliency
- Determine the benefits and costs of restoration and include the development of models to understand these costs and benefits
- Evaluate the effectiveness of the educational programs related to our natural resources and improve the methodologies of sharing information with the public so that communities can make more informed decisions

### **Apply understanding of marine ecosystems to develop appropriate indicators and metrics for sustainable use and effective management (ORPP RP16)**

#### Top Tier Gulf of Mexico Priority

- Determine the correct variables to use as indicators of ecosystem health, identify the optimal methods to measure the indicators, and design better-defined indices with more indicators to evaluate the status of ecosystems

#### Second Tier Gulf of Mexico Priority

- Design rapid field-based standardized tests for the detection of specific variables that will identify the presence of bacteria, contaminants, toxins, and pathogenic organisms at harmful levels

## **ORPP Theme: Stewardship of Natural and Cultural Resources**

### **Understand interspecies and habitat/species relationships to support forecasting resource stability and sustainability (ORPP RP2)**

#### Top Tier Gulf of Mexico Priorities

- Identify connections among habitats and connections between habitats and living marine resources
- Model resource stability and sustainability and include interactions between fisheries, habitat, threatened and endangered species, ecosystem processes, and stressors to assist with making ecosystem-based management decisions
- Examine changes in habitat quality and quantity over time and identify the effects of changes on marine organisms including the threshold level of habitat quality and quantity required to support sustainable populations of living resources

### Second Tier Gulf of Mexico Priorities

- Analyze the trophic relationships of commercially valuable species, endangered species, and invasive species and predict ecosystem changes influencing the removal of commercially valuable species
- Determine how resource diversity and abundance responds to changes in ecosystem structure and function; identify what changes are caused by natural versus anthropogenic causes; and analyze the relationship between living resource sustainability and water quality, invasive species, tourism, coastal development, urban development, land use, and marine aquaculture
- Examine the impact of climate change on fish ecology, mortality, fecundity, recruitment, distribution, migration, and predator-prey interaction
- Evaluate the relative importance of different sites in the Gulf of Mexico that support resource abundance and diversity by examining water circulation, gene flow, larval transport and connectivity of habitats and populations in the region
- Formulate a method to measure the effectiveness of Marine Protected Areas

### **Understand human-use patterns that may influence resource stability and sustainability (ORPP RP3)**

#### Second Tier Gulf of Mexico Priorities

- Establish the value of Gulf of Mexico ecosystem services, including depleted and renewable resources
- Model the value of various habitats and ecosystems to allow for informed decisions on the placement, construction, development, and expansion of marine facilities and operation

### **Apply advanced understanding and technologies to enhance benefits of various natural resources from the open ocean and coasts (ORPP RP4)**

#### Second Tier Gulf of Mexico Priorities

- Identify methods for improving aquaculture grow-out technology for stock enhancement and other purposes and examine the environmental and economic impacts of marine and estuarine aquaculture in the Gulf of Mexico including the impacts of mariculture in shallow, warm waters
- Evaluate innovative uses of oil platforms such as generating alternative energy, collecting weather data, developing ecotourism options, and rearing marine organisms

### **Understand the status and trends of resource abundance and distribution through more accurate, timely, and synoptic assessments (ORPP RP1)**

#### Second Tier Gulf of Mexico Priority

- Develop more accurate assessments of biodiversity on a micro (genetic and molecular ecology) and macro (population) level

## ORPP Theme: Increase Resilience to Natural Hazards

### **Apply understanding to develop multi-hazard risk assessments and support development of models, policies, and strategies for hazard mitigation (ORPP RP7)**

#### Top Tier Gulf of Mexico Priorities

- Determine and predict the physical impacts of climate change on coastal and upland areas in terms of sea level change, rate of elevation change, shoreline change, loss of barrier islands, role of coastal development in preventing migration of marshes and other habitats, and change in inland, coastal, and ocean hydrology and apply this knowledge in habitat restoration efforts
- Examine the public's perception of sea level change; evaluate hazard-related communications and people's change in behavior in relation to hazard mitigation; and identify approaches that local governments are employing to adapt to sea level change
- Predict socioeconomic impacts of climate and sea level change on population dynamics, community infrastructure, short- and long-term community demographic shifts, social capital, and commerce and shipping centers

#### Second Tier Gulf of Mexico Priorities

- Characterize and model community and ecological resilience to natural hazards considering the ecological footprint and level of vulnerability of the built environment and identify methods to reduce losses; and model the attributes, factors, and strategies that contribute to making a community successfully resilient

### **Understand response of coastal and marine systems to natural hazards and apply that understanding to assessments of future vulnerability to natural hazards (ORPP RP6)**

#### Top Tier Gulf of Mexico Priorities

- Determine how storm surge, subsidence and sea level change affects ecosystems, native coastal habitat, wetland composition, saltwater intrusion, coastal flooding, cultures, agriculture, and human health
- Identify the optimal use and allocation of sediment and evaluate the rates of shoreline change from anthropogenic and natural impacts including sediment mobilization, transport, and deposition from major storm events

#### Second Tier Gulf of Mexico Priorities

- Analyze how coastal and nearshore morphology, vegetation, beaches, dunes, coastal forests, and wetlands protect inland areas from hurricane impacts by absorbing wind and storm surge energy; and determine the economic value (e.g. costs and benefits) of natural protective features

### **Understand how hazard events initiate and evolve, and apply that understanding to improve forecasts of future hazard events (ORPP RP5)**

#### Second Tier Gulf of Mexico Priorities

- Design updated real-time storm surge models and products that include meteorological, land use and land cover, and improved boundary data to better predict impacts from storms

## ORPP Theme: Enhancing Human Health

### **Understand sources and processes contributing to ocean-related risks to human health (ORPP RP17)**

#### Second Tier Gulf of Mexico Priorities

- Determine how environmental factors (e.g. sea temperature, salinity, industrial discharge, agricultural inputs, freshwater inflow, and water quality) and large-scale events (e.g. climate change and tropical storms) influence the occurrence, intensity, and duration of harmful algal blooms, toxins, and pathogens and develop harmful algal bloom transport models for near shore waters
- Incorporate integrated studies to examine the affects and transport of wastewater on human health, drinking water, and water quality including improving the ability to identify contaminant sources such as raw and partially treated sewage

### **Understand human health risks associated with the ocean and potential benefits of ocean resources to human health (ORPP RP18)**

#### Second Tier Gulf of Mexico Priorities

- Examine and predict how changes in water quality, temperature, runoff, and mercury levels impact seafood safety and quality and determine the effects of bioaccumulation, harmful algal blooms and other harmful substances on the safety of seafood products
- Identify the relationship between temperature change and Vibrio species and improve prediction capabilities related to the occurrence and duration of this pathogen in a given body of water

### **Apply understanding of ocean ecosystems and biodiversity to develop products and biological models to enhance human well-being (ORPP RP20)**

#### Second Tier Gulf of Mexico Priority

- Analyze marine and coastal derived products to determine their potential for pharmaceuticals and other biological-based products

## ORPP Theme: The Ocean's Role in Climate

### **Understand the impact of climate variability and change on the biogeochemistry of the ocean and implication for its ecosystems (ORPP RP12)**

#### Top Tier Gulf of Mexico Priorities

- Determine changes in freshwater, nutrient, pollution, groundwater and sediment input due to changes in pattern and quantity of precipitation and predict the subsequent impact of these inputs on geochemical and physical coastal processes and biological (including benthic and epibenthic) communities

#### Second Tier Gulf of Mexico Priority

- Develop and validate numerical circulation models and techniques for data assimilation
- Evaluate the best locations for sensors to record climatological, wind, atmospheric, and ocean circulation data and use Observation System Simulation Experiments (OSSE) to determine optimal placement of sensors

Note: Other climate-related research priorities are captured elsewhere in this document.

## ORPP Theme: Enabling Marine Operations

### Understand the interactions between marine operations and the environment (ORPP RP8)

#### Top Tier Gulf of Mexico Priority

- Examine how river diversions and the placement of sediment impact water quality, sediment processes, shoaling, coastal processes, fisheries, habitat utilization by organisms, and marshes and other habitats

#### Second Tier Gulf of Mexico Priority

- Determine impacts of past and present navigation practices, shipping including shallow-draft PANAMAX super-containers, port facilities, shallow-water dredging and non-dredging sediment management on water and air quality, sediment transport, land loss and erosion, circulation, ecosystem health, and human health