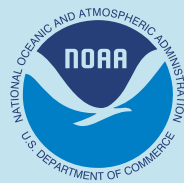


# LOUISIANA MARINE MAMMAL RESTORATION STRATEGY





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*Cover Photo: Salt Marsh in Barataria Basin, Eric J. Ward/USGS*

*Cover Photo: Bottlenose dolphin (NMFS Permit #19293), Laura Engleby/NOAA*

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## PREFACE

The National Oceanic and Atmospheric Administration (NOAA) Restoration Center contracted the Water Institute (the Institute) to support the development of a Louisiana Marine Mammal (MM) Strategy (herein referred to as the Strategy; this document) as part of NOAA's Damage, Assessment, Remediation and Restoration Program (DARRP). This activity was funded by the Deepwater Horizon (DWH) oil spill Louisiana Trustee Implementation Group (LA TIG) with the goal of the Strategy supporting development of a MM Restoration Plan for the Louisiana Restoration Area, including coastal and offshore waters, to address MM injuries caused by the oil spill. Marine mammals were one of many restoration types identified in the DWH oil spill Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS; DWH NRDA Trustees, 2016a), and within that plan, approximately \$50 million was allocated for MM restoration in the Louisiana Restoration Area to compensate for MM injuries caused by the oil spill.

Several challenges—and opportunities—exist related to the development and successful implementation of the MM Restoration Plan, informed by this Strategy, for Louisiana. Project selection, sequencing, timing, funding levels, and evaluation all need careful consideration. Further, successful implementation of the MM Restoration Plan will require cooperation, collaboration, and partnership with partners including academic institutions, non-government experts, local fishing communities, state agencies and government, and local government and community leadership, and so must also reflect their interests. As such, a successful Louisiana MM restoration effort is more likely to succeed if founded on a robust Strategy tailored to the state's unique challenges. This Strategy document identifies a framework for restoration actions and along with potential actions; engagement needs and opportunities, along with key partnerships; key themes and priorities; and their connection to other relevant MM restoration and Monitoring and Adaptive Management (MAM) activities by groups with a geographic interest in Louisiana.



## ACKNOWLEDGEMENTS

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## LIST OF ACRONYMS AND ABBREVIATIONS

| Acronym | Term                                                     |
|---------|----------------------------------------------------------|
| AAR     | Audubon Aquarium Rescue                                  |
| BSE     | Bay, Sound, and Estuary                                  |
| DARRP   | Damage, Assessment, Remediation, and Restoration Program |
| DIDSON  | Dual-frequency IDentification SONar                      |
| DWH     | Deepwater Horizon                                        |
| LAMMSN  | Louisiana Marine Mammal Stranding Network                |
| LA TIG  | Louisiana Trustee Implementation Group                   |
| LDWF    | Louisiana Department of Wildlife and Fisheries           |
| MAM     | Monitoring and Adaptive Management                       |
| MM      | Marine Mammal                                            |
| MMPA    | Marine Mammal Protection Act                             |
| NEPA    | National Environmental Policy Act                        |
| NGO     | Non-Governmental Organization                            |
| NOAA    | National Oceanic and Atmospheric Administration          |
| NRDA    | Natural Resource Damage Assessment                       |
| PDARP   | Programmatic Damage Assessment and Restoration Plan      |
| PEIS    | Final Programmatic Environmental Impact Statement        |
| SDM     | Structured Decision-Making                               |
| SME     | Subject Matter Expert                                    |
| TIG     | Trustee Implementation Group                             |
| UHMWPE  | Ultra-High-Molecular-Weight-PolyEthylene                 |



## 1. INTRODUCTION

The National Oceanic and Atmospheric Administration (NOAA) Restoration Center partnered with The Water Institute (the Institute) to develop this Marine Mammal (MM) Restoration Strategy (herein referred to as the Strategy) for the Louisiana Restoration Area (Figure 1). This Strategy is intended to support development of a future MM Restoration Plan, and is part of supporting NOAA and other Trustees in restoring resources damaged during the Deepwater Horizon (DWH) oil spill. The purpose of the Strategy—and the Restoration Plan it is intended to inform—is to ensure that DWH Natural Resource Damage Assessment (NRDA) funds are dedicated to compensating for MM injuries in Louisiana, and that those funds are directed toward the most beneficial and logistically sound actions for restoration of MM populations that inhabit Louisiana’s coastal and offshore waters. To be fully implementable, the Restoration Plan must consider multiple challenges specific to Louisiana including remote locations, logistical constraints, limited capacity and experience, competing interests, restrictive funds, limited local support, uncertainty in MM threats and stressors, and changing environmental conditions.

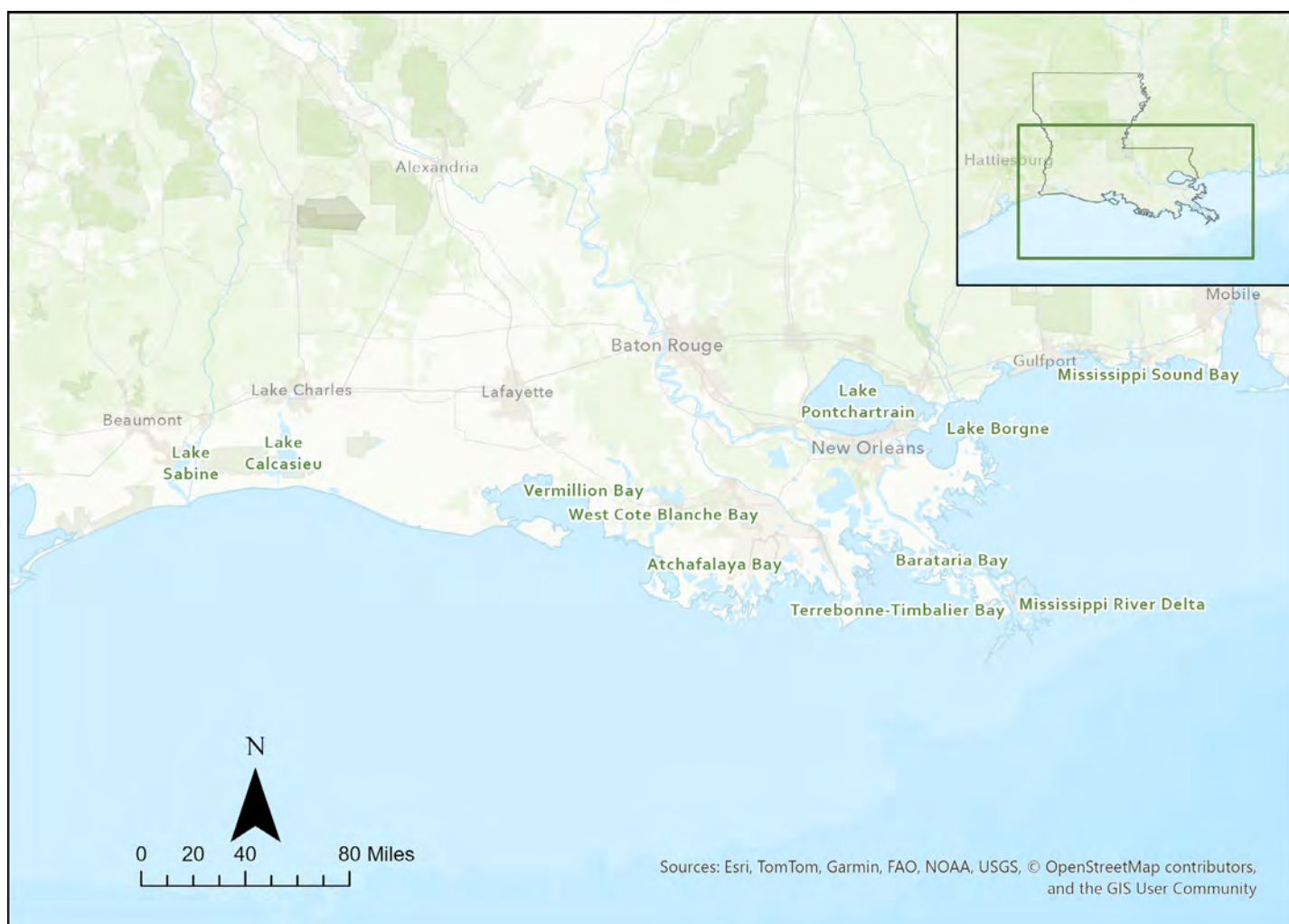


Figure 1. Map showing points of reference in Louisiana, the focus area of the MM Strategy.



The main goal of this Strategy is to outline a programmatic approach to support sustainable, long-term restoration of dolphins which supports the Restoration Plan. MM are long-lived megafauna, necessitating a long-term approach to ensure populations impacted by the oil spill benefit from restoration actions, recover, and are sustainable. The Institute and NOAA worked collaboratively on this Strategy to identify the intersection with relevant Programmatic Damage and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS) restoration approaches, articulate objectives for how they can be operationalized strategically in Louisiana as a portfolio, and prioritize them for funding in the short- and long-term. While the PDARP/PEIS describes a number of restoration approaches that are applicable to MMs in Louisiana (Deepwater Horizon NRDA Trustees, 2016), successful implementation depends on developing appropriate capacity and partnerships at the community, regional, and state level as well as recognizing that the scale, complexity, and timeframe of MM restoration in Louisiana benefits from a programmatic approach rather than a series of individual projects. This Strategy therefore aims to identify key partnerships; a common framework for restoration action as part of programmatic approach; potential restoration actions; engagement needs and opportunities; and key themes and priorities, along with their connection to relevant MM restoration and Monitoring and Adaptive Management (MAM) activities advanced by organizations with a geographic interest in Louisiana. Monitoring dolphin populations and addressing data gaps are critical components of informed restoration and those efforts are summarized in “Monitoring Plan for Common Bottlenose Dolphin Stocks across Louisiana Basins and Nearshore Coastal Waters” (LA TIG, 2025d), developed through the Louisiana Trustee Implementation Group (LA TIG) MAM process. This Strategy is therefore intentionally focused on the programmatic, partnership, and human dimensions needed to implement and sustain restoration over the long-term.



*Bottlenose dolphin (MMPA Permit No 14450). Photo credit: NOAA*



## 2. BACKGROUND

### 2.1 Deepwater Horizon

In April 2010, the DWH oil spill, the largest marine oil spill in U.S. history, released roughly 134 million gallons of oil over 87 days, contaminating habitats across nearshore and offshore waters where MMs reside. The scale of injury to MMs from the DWH oil spill was unprecedented. At least 22 stocks representing 15 species of MMs overlapped with the spill footprint and sustained quantifiable injuries, such as increased mortality, reproductive failure, and adverse health effects, all of which contributed to the largest and longest MM unusual mortality event on record in the northern Gulf (DWH NRDA Trustees, 2016a).

In 2016, the DWH NRDA Trustees released the Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS) which identified five restoration goals under the broader programmatic goal of replenishing and protecting living coastal and marine resources (DWH NRDA Trustees, 2016b).

For MMs, the PDARP identified the following restoration goals:

1. Implement an integrated portfolio of restoration approaches to restore injured bay, sound, and estuary (BSE), coastal, shelf, and oceanic MMs across the diverse habitats and geographic ranges they occupy.
2. Identify and implement restoration activities that mitigate key stressors to support resilient populations.
3. Collect and use monitoring information, such as population and health assessments, and spatiotemporal distribution information.
4. Identify and implement actions that support ecological needs of the stocks; improve resilience to natural stressors; and address human-caused threats such as bycatch in commercial fisheries, vessel collisions, noise, industrial activities, illegal feeding and harassment, and hook-and-line interactions.

The PDARP/PEIS also established that robust monitoring and adaptive management would be essential components of the MM restoration portfolio given limited experience implementing restoration at this scale and the limited scientific data on population-level impacts. MM restoration funds were allocated across multiple TIGs, corresponding to different geographic Restoration Areas, with a particular emphasis on the Louisiana Restoration Area to reflect the diversity of species injured and the geographic distribution of the injury.

The DWH Trustees also developed a Strategic Framework for Marine Mammal Restoration Activities in 2017 to provide additional context, prioritization, and sequencing of MM restoration across all states and TIGs in the northern Gulf (DWH NRDA Trustees, 2017). The Framework was intended to help Trustees implement restoration at the local and region-wide level, and to promote coordination, information sharing, and common monitoring approaches. Restoration approaches identified included: reducing commercial fishery bycatch; addressing impacts of anthropogenic noise; reducing hook and line interactions; improving stranding response and early detection of threats; addressing illegal feeding and harassment; reducing vessel collisions; reduce marine mammal takes through enhanced enforcement, and protecting MM habitat (DWH NRDA Trustees, 2017). The Framework also emphasized a phased approach to restoration, understanding that data collection and monitoring would be needed to inform restoration decision-making over time.



## 2.2 Marine Mammals

MMs in the Gulf of America (Gulf) inhabit a broad range of habitats, from offshore waters and the continental shelf to coastal BSEs. All MMs are federally protected under the Marine Mammal Protection Act (MMPA), and species in U.S. waters are managed as demographically distinct stocks based on site fidelity, genetics, and other data. In the northern Gulf, NOAA has identified 31 BSE bottlenose dolphin stocks. Although these dolphins occasionally move into nearshore waters, they tend to spend most of their time within their home BSEs.

Nine bottlenose dolphin stocks occur in Louisiana state waters (Figure 1). Seven stocks live year-round in BSEs: Sabine Lake, Calcasieu Lake, Vermilion Bay/West Cote Blanche Bay/Atchafalaya Bay, the Terrebonne-Timbalier Bay Estuarine System, the Barataria Bay Estuarine System, the Mississippi River Delta, and the Mississippi Sound/Lake Borgne/Bay Boudreau. Two additional stocks occupy coastal waters: the Northern Coastal and Western Coastal stocks (Hayes et al., 2024). Except for the two most western BSE stocks (Calcasieu Lake, Vermilion Bay/West Cote Blanche Bay/Atchafalaya Bay) all other stocks overlapped with the DWH oil spill footprint (Hayes et al., 2024; NOAA, 2021). The Barataria Bay Estuarine Stock and the Mississippi Sound, Lake Borgne, and Bay Boudreau stocks were the most severely injured from the DWH oil spill resulting in increased mortality, increased reproductive failure, and adverse health effects such as adrenal disease, lung disease, and poor body condition (NOAA, 2021; Venn-Watson et al., 2015). The Barataria Bay and Mississippi Sound bottlenose dolphin stocks are two of the most studied populations and it is estimated their populations declined by 51%–62% due to the oil spill (Schwacke et al., 2015; NOAA, 2021).

There are several factors that must be considered in prioritizing and planning actions to address the harm bottlenose dolphins incurred during DWH. Bottlenose dolphins are long-lived, with female dolphins typically living into their 50s and possibly 60s and males living into their 40s and possibly 50s (Wells & Scott, 2009). These animals are also slow to reproduce, reaching sexual maturity at ~6–9 years old for females and ~10 years old for males. The gestation is approximately 1 year with calving intervals between 3–6 years (Wells et al., 2025). The long lifespan and slow reproductive rate for bottlenose dolphins means that it will take decades for dolphin populations to recover from a catastrophic event like the DWH oil spill. For example, due to the DWH oil spill, the Barataria Bay stock faced a projected maximum population reduction of 51%, and without active restoration would require 40–50 years to recover (Schwacke et al., 2017).

*Audubon Aquarium Rescue (AAR) dolphin rescue and release in September 2020. Marine mammal rescue activities permitted under MMPA Permit No. 24359. Marine mammal activities conducted under a stranding agreement between Audubon Nature Institute and NMFS under the MMPA. Photo credit: Audubon Nature Institute*





Bottlenose dolphin recovery in Louisiana is also related to the interconnected and cumulative suite of threats and stressors they encounter, including human impacts, disease, contaminants, and environmental stressors that affect animals at the individual and population level (LA TIG, 2025a). To inform restoration planning, the LA TIG supported a systematic effort to characterize threats and stressors through literature reviews and scoring systems. The top three stressors identified were oil and gas pollution, extreme weather (and the risk of entrapment), and infectious disease (LA TIG, 2025b). These align with similar priority stressors identified in the National Marine Mammal Health and Monitoring Surveillance Report (Marine Mammal Commission, 2024). The top human-caused threats were net and trap fisheries (including commercial shrimping, skimmer trawls, menhaden fisheries, and crab pots), large shipping vessels, dredging and construction, and hook-and-line fisheries. It is worth noting that large shipping vessels scored high in part due to significant geographic overlap with dolphin habitat rather than reflecting the per-encounter risk alone and that small vessels remain a greater concern to dolphins in bays, sounds, and estuaries. These findings are consistent with both the 2016 DWH PDARP/PEIS and the 2017 Region-wide Strategic Framework for Marine Mammal Restoration which identified commercial net fisheries (e.g., shrimp, menhaden), hook and line interactions, harmful algal blooms, contaminants, vessel strikes, and illegal feeding as priority threats. Thus, the LA TIG-supported analyses point to the same threats and stressors identified in earlier assessments, underscoring both the persistence of these pressures and the continued need for restoration.

Lastly, there are several ongoing and completed restoration efforts related to bottlenose dolphins in Louisiana and surrounding states which were considered for synergy and leveraging opportunities with the Strategy, and which can inform the Restoration Plan. See Table 1 for additional information.





Table 1. Ongoing and completed restoration efforts, supported through Natural Resource Damage Assessment (NRDA) funds from the Deepwater Horizon (DWH) oil spill and related to bottlenose dolphins in Louisiana and surrounding states, which have potential synergy with this Strategy and the as-yet developed MM Restoration Plan. Projects span coastal and Bay, Sound, and Estuary (BSE) areas, and across the state of Louisiana (LA); Alabama (AL); Florida (FL); Mississippi (MS); and Texas (TX). Start Year and Estimated Duration are from the linked project websites.

| Trustee Implementation Group | Project Title and Link                                                                                                                                                                                                             | Objective and Description                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Species and Geography                                              | Start Year, Estimated Duration | Status             | Authorized Budget |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------|--------------------|-------------------|
| LOUISIANA                    |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                    |                                |                    |                   |
| Louisiana MM Restoration     | Assessment of Marine Mammal Physiological Responses to Low Salinity Exposures<br><a href="https://gulfsplrestoration.noaa.gov/project?id=128">https://gulfsplrestoration.noaa.gov/project?id=128</a>                               | Supported understanding and restoration of bottlenose dolphins using existing data to synthesize animal responses to low salinity exposure (Booth & Thomas, 2021; McClain et al., 2020)                                                                                                                                                                                                                                                                                        | Bottlenose dolphins in Barataria Bay, Louisiana                    | 2018<br>2 years                | Completed          | \$205K            |
| Louisiana MAM                | Louisiana Marine Mammal Abundance, Distribution, and Density<br><a href="https://gulfsplrestoration.noaa.gov/project?id=127">https://gulfsplrestoration.noaa.gov/project?id=127</a>                                                | Conducted vessel-based photo-identification studies to understand baseline population and evaluate DWH Restoration (Garrison et al., 2020)                                                                                                                                                                                                                                                                                                                                     | Bottlenose dolphins in Barataria Bay, Louisiana                    | 2019<br>2 years                | Completed          | \$298K            |
| Louisiana MM Restoration     | Louisiana Enhanced Marine Mammal Stranding Network<br><a href="https://gulfsplrestoration.noaa.gov/project?id=256">https://gulfsplrestoration.noaa.gov/project?id=256</a>                                                          | Address personnel and data gaps, expand partnerships, and enhance current capabilities of the Marine Mammal Stranding Network and inform restoration planning, monitoring, and adaptive management                                                                                                                                                                                                                                                                             | All cetaceans, including BSE and coastal bottlenose dolphins in LA | 2021<br>5 years                | In Progress        | \$3.1M            |
| Louisiana MAM                | Monitoring Approaches for Bottlenose Dolphin Restoration in Louisiana<br><a href="https://gulfsplrestoration.noaa.gov/project?id=301">https://gulfsplrestoration.noaa.gov/project?id=301</a>                                       | Develop study designs in LA to: (1) monitor BSE bottlenose dolphins (LA TIG, 2025d); (2) characterize human-caused threats (LA TIG, 2025a); (3) characterize impacts of freshwater to dolphins (LA TIG, 2025c); (4) develop a framework for assessing risk of infectious and non-infectious disease and contaminant hazards (LA TIG, 2025b); and (5) develop, validate, and test hardware/software for tags capable of measuring salinity when attached to dolphin dorsal fins | BSE and coastal bottlenose dolphins in Louisiana                   | 2023<br>5 years                | In Progress        | \$770K            |
| MISSISSIPPI                  |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                    |                                |                    |                   |
| Mississippi MM Restoration   | Maintaining Enhanced Marine Mammal Stranding Network Capacity and Diagnostic Capabilities<br><a href="https://gulfsplrestoration.noaa.gov/project?id=310">https://gulfsplrestoration.noaa.gov/project?id=310</a>                   | Maintain enhanced capacity of the MS Marine Mammal Stranding Network                                                                                                                                                                                                                                                                                                                                                                                                           | All cetaceans in MS                                                | 2023<br>3 years                | In Progress        | \$2.35M           |
| Mississippi MM Restoration   | Reduction of Marine Mammal Fishery Interactions through Trawl Technique and Component Material Improvements<br><a href="https://gulfsplrestoration.noaa.gov/project?id=311">https://gulfsplrestoration.noaa.gov/project?id=311</a> | Decrease the number of interactions and mortality associated with skimmer trawls in MS while maintaining catch and efficiency by investigating gear modifications                                                                                                                                                                                                                                                                                                              | Bottlenose dolphins, MS                                            | 2027<br>5 years                | Pre-Implementation | \$3.09M           |



| Trustee Implementation Group | Project Title and Link                                                                                                                                                                                                                                   | Objective and Description                                                                                                                                                                                                                             | Species and Geography                                            | Start Year, Estimated Duration | Status             | Authorized Budget |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------|--------------------|-------------------|
| REGIONWIDE                   |                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                       |                                                                  |                                |                    |                   |
| Regionwide MM Restoration    | Enhance Marine Mammal Stranding Diagnostic Capabilities and Consistency Across the Gulf of America<br><a href="https://gulfsillrestoration.noaa.gov/project?id=294">https://gulfsillrestoration.noaa.gov/project?id=294</a>                              | Support MM stranding network capacity and diagnostic capabilities to improve treatment and care of live stranded animals and supporting data collection and consistency (Regionwide TIG, 2022);                                                       | All cetaceans in AL, FL, LA, MS, TX                              | 2022<br>5 years                | In Progress        | \$2.3M            |
| Regionwide MM Restoration    | Reducing Impacts to Dolphins from Hook-and-Line Gear and Provisioning through Fishery Surveys, Social Science and Collaboration<br><a href="https://gulfsillrestoration.noaa.gov/project?id=340">https://gulfsillrestoration.noaa.gov/project?id=340</a> | Reduce interactions between dolphins and hook and line fishing gear and fishing practices through surveys and co-production of potential solutions (phase 1; an unfunded phase 2 could include implementation)                                        | Bottlenose dolphins in AL, FL, LA, MS, TX                        | 2023<br>3 years                | In Progress        | \$1.7M            |
| Regionwide MM Restoration    | Voluntary Modifications to Commercial Shrimp Lazy Lines to Reduce Dolphin Entanglements<br><a href="https://gulfsillrestoration.noaa.gov/project?id=341">https://gulfsillrestoration.noaa.gov/project?id=341</a>                                         | Decrease the number of entanglements associated with dolphin mortality in the lazy lines of commercial shrimp vessels through research and working collaboratively with stakeholders                                                                  | Bottlenose dolphins in FL, LA, MS, TX                            | 2027<br>7 years                | Pre-Implementation | \$3.2M            |
| OPEN OCEAN                   |                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                       |                                                                  |                                |                    |                   |
| Open Ocean MM Restoration    | Reducing Impacts to Cetaceans during Disasters by Improving Response Activities<br><a href="https://gulfsillrestoration.noaa.gov/project?id=230">https://gulfsillrestoration.noaa.gov/project?id=230</a>                                                 | Improve and enhance whale and dolphin response activities in the Gulf to address a variety of potential disasters (Open Ocean TIG, 2023)                                                                                                              | Cetaceans in AL, FL, LA, MS, TX, and offshore waters in the Gulf | 2020<br>10 years               | In Progress        | \$4.29M           |
| Open Ocean MM Restoration    | Developing Methods to Observe Sea Turtle Interactions in the Menhaden Purse Seine Fishery<br><a href="https://gulfsillrestoration.noaa.gov/project?id=220">https://gulfsillrestoration.noaa.gov/project?id=220</a>                                       | Worked with the Gulf menhaden purse seine industry to develop effective observer methods and identify opportunities for voluntary measures to reduce interactions with sea turtles and other protected species (e.g., dolphins; Open Ocean TIG, 2024) | Sea turtles and bottlenose dolphins off AL, MS, and LA.          | 2020<br>3 years                | Completed          | \$3M              |



## 2.3 Needs For The Strategy

As part of this effort, the Institute initially worked with subject matter experts (SMEs) to identify key needs the Strategy should address (Minor, Cowan, Carruthers, et al., 2025). That engagement helped frame and scope the work and provided guidance in developing the Strategy.

These identified needs, most of which are consistent with explicit needs stated within the PDARP, include:

- Develop sustainable and durable MM restoration plans and actions in the state of Louisiana. These plans should also account for attitudes, behaviors, and beliefs that drive human-MM interactions.
- Collaborate with federal and state entities on existing actions, relationships, and plans for Louisiana MM restoration.
- Better understand the role of dolphin behavior in existing threats and stressors.
- Support health outcomes for MMs as a function of detection and mitigation of direct stressors (e.g., disease, contaminants, and freshwater), but also of habitat quality characterized by prey, environmental factors, and exposure to stressors.
- Support a robust stranding network comprised of coordinated organizations and volunteers.
- Encourage and enable partnership and collaboration at the institutional level.



### 3. METHODS

The Institute and NOAA project team (hereafter, the team) developed the Strategy using structured decision making (SDM), an objectives-orientated approach to identifying and evaluating alternatives for complex problems where there are multiple objectives and concerns (Dalyander et al., 2016; Hammond et al., 1999; Keeney, 2004). The team chose SDM because this method provides a transparent, replicable structure for identifying and trading off across objectives, which is important for developing a robust Strategy that is implementable and has the support of key partners. SDM is also an established technique grounded in the social sciences that draws from the fields of decision analysis, operations research, human dimensions, and behavioral psychology (Hammond et al., 1999), which has been designed to minimize the influence of human biases and to incorporate data and information of various types into evaluation of alternatives as part of making those tradeoffs.

SDM breaks down a decision-making process into a set of steps designed to systematically identify and weigh alternatives while minimizing the potential for biases to influence the decision (Figure 2). Those steps are collectively referred to as the ProACT cycle and include: (1) clarification of the **P**roblem or decision-context; (2) articulating the **O**bjectives of the decision makers and stakeholders; (3) identifying **A**lternatives that can advance those objectives; (4) evaluating the **C**onsequences of potential alternatives on the desired objectives; and (5) considering **T**radeoffs as part of optimizing selection of an alternative to ultimately support deciding and acting. Here, the decision was what themes to include in the Strategy, as well as what types of partners to engage in refining and ultimately advancing those areas.



Figure 2. Structured Decision-Making (SDM) ProACT cycle, which consists of identifying the Problem or decision context; articulating Objectives; specifying Alternative courses of action; evaluating Consequences; considering Tradeoffs and optimizing; and taking action.



### 3.1 SDM Rapid Prototyping

The team used rapid prototyping, a lightweight version of SDM that implements the ProACT cycle with a small group of MM and Louisiana experts who completed the steps based on their own expertise rather than using detailed modeling or analysis (Dalyander et al., 2024). Rapid prototyping is often used as a preliminary step to frame the decision and related considerations, as well as to focus future analysis. Here, rapid prototyping was used to identify the problem context, objectives, and potential restoration actions, as well as to hypothesize on the potential outcomes or tradeoffs of those actions as part of identifying and refining Strategy themes. The specific actions identified are not necessarily those that would be included or advanced in the Restoration Plan informed by this Strategy, but by identifying and evaluating them, the team was better able to identify key concepts, themes, and partners for the Strategy and its eventual implementation. In addition to SDM, the Institute conducted interviews with representatives of established MM programs (Appendix B) to further identify and refine these concepts and themes.

SDM rapid-prototyping was conducted through a series of working sessions with Institute and NOAA personnel representing MM and LA expertise. These sessions built upon and refined a draft decision context and objectives that were initially identified through working sessions with SMEs and in coordination with the NOAA Southeast Regional Office MM Branch (Minor, Cowan, Carruthers, et al., 2025).

The decision-context for the Strategy is:

To develop a community of care for MMs in inshore, coastal, and offshore waters of Louisiana that supports thriving MM populations, NOAA needs to develop a Strategy that articulates the strategic partnerships and restoration investments over 15+ years that achieve both thriving MM populations and a long-term collaborative partner network. To be fully implementable, the Strategy needs to consider remote locations, logistical constraints, limited capacity and experience, competing interests, restrictive funds, limited local support, uncertainty in MM threats, and changing environmental conditions.

This decision context articulates the long-term goal of the Strategy to support thriving MM populations through strategic partnering and investments. In addition, the decision context identifies considerations relevant to Strategy development, such as practical and logistical constraints and the need to consider tradeoffs and uncertainties associated with MM sustainability.

The team also identified SDM “fundamental objectives,” those that are foundationally important and provide benchmarks for evaluating potential alternatives.

An initial set of fundamental objectives (Minor, Cowan, Dausman, et al., 2025) was identified based on input from SMEs:

- Maximize cost efficiency of MM restoration projects;
- Improve MM viability over 20 years;
- Increase available knowledge to inform adaptive management;
- Minimize costs of filling knowledge gaps; and
- Maximize long-term engagement and support for implementation.



These objectives were focused and refined during rapid prototyping for the purpose of considering tradeoffs of potential actions. The timeframe of improving MM viability would ideally be in perpetuity, but a period of 20 years was chosen for this fundamental objective to represent the period over which actions taken now are likely to impact MM populations. Two of the initial objectives (maximize cost efficiency of MM restoration projects, minimize costs of filling knowledge gaps) included expense considerations, which were combined to a single fundamental objective of minimizing implementation costs overall. The objective to increase available knowledge to inform adaptive management was refined to focus on the overall effectiveness of adaptive management, which could result from increased knowledge or from better pathways for incorporating that knowledge into practice. The team recharacterized knowledge gathering as an overarching need that would need to be incorporated within any potential action that had critical uncertainties. Lastly, a fundamental objective was added around minimizing staff time spent implementing projects in recognition that doing so, assuming other objectives are advanced, allows for more actions to be taken to advance the primary objective of improving MM viability.

The revised set of fundamental objectives, used for evaluation of potential actions solely for the purposes of building a common action framework and identifying partnership needs, included:

1. Improve marine mammal viability over 20 years;
2. Minimize implementation costs as part of maximizing the cost efficiency of marine mammal restoration projects;
3. Increase the effectiveness of adaptive management;
4. Maximize long-term engagement and support for implementation of marine mammal management; and
5. Limit the staff implementation time needed as part of maximizing the efficiency of marine mammal restoration projects.

## 3.2 SDM Alternatives

Next, the team refined a list of potential actions initially identified through working sessions with SMEs (Minor, Cowan, Carruthers, et al., 2025). That exercise generated an extensive list of potential activities, which were first cross-referenced with PDARP/PEIS approaches to refine to a list of activities consistent with that document. Then, the list was further refined to ensure that each potential action is a complete activity (i.e., one that includes all necessary steps to lead directly to the restoration of MMs). These complete activities, each with an identified pathway to MM benefit, became the SDM alternatives. These alternatives were then used to help identify common themes and key partners for Strategy development. Note, alternatives here refers to MM restoration activities evaluated in SDM rapid prototyping for the purposes of developing a framework for the Strategy and does not refer to or connote alternatives for the National Environmental Policy Act (NEPA) or other regulatory contexts.



The SDM alternatives are a subset of the potential actions that may be included within the Restoration Plan. These alternatives included:

- decrease incidences of intentional harm to dolphins associated with commercial fishing;
- decrease dolphin mortality associated with menhaden purse seine fisheries;
- decrease entanglements in crab pot gear; decrease dolphin entanglement in otter trawl gear;
- decrease dolphin entanglement in skimmer trawl gear and decrease dolphin damage to skimmer trawl nets;
- reduce entrapment risk to dolphins during construction; enhance MM stranding network in Louisiana;
- increase/protect prey availability for MMs in Louisiana;
- decrease interactions associated with hook and line fisheries; decrease interactions associated with tourism and boating;
- decrease intentional harm associated with recreational fisheries interactions; decrease illegal feeding of MMs associated with recreational fishing;
- develop strategies that mitigate environment-related disease;
- develop research to improve ecosystem and population-level understanding of MMs in Louisiana; and
- decrease feeding associated with recreational fish cleaning stations.

The final alternative on the list—decrease feeding associated with recreational fish cleaning stations—was added by the project team based on preliminary discussion. Actions around research and partnerships were identified, but the team determined they were overarching activities that would best advance the objectives by including them throughout the other alternatives based on increasing effectiveness, cost-efficiency, or the potential for adaptive management.

The team then conducted a preliminary assessment of these alternatives to prioritize which potential actions should be used in identifying themes and partners for the Strategy. The assessment consisted of team members individually evaluating each of the listed alternatives against the five fundamental objectives on a scale of 1 to 3, where 1 corresponded to a negative impact of the activity on the objective; 2 corresponded to a neutral (or no) impact on the objectives; and 3 corresponded to a positive impact on the objective.

Evaluators were similarly asked to provide a ranking evaluating uncertainties on a scale of 1 to 3 (low to high uncertainty) across categories of:

- scientific uncertainty: i.e., the uncertainty associated with whether the type or level of impact the alternative would have on MMs;
- logistical uncertainty: i.e., the uncertainty associated with whether the alternative was practically feasible;
- partnership uncertainty: i.e., the uncertainty associated with whether critical partners would be interested in engaging to support the alternative; and
- uncertainty in the necessary level of time and investment.

After team members determined their individual rankings across all objectives and uncertainties for an objective, the team then shared their scores and discussed them to assign a single, consensus-based rank. When there was no immediate consensus, team members discussed the rationale for their rankings and their associated questions or concerns. The team was ultimately able to reach consensus scores for every alternative, with recognition that these scores were only being used as a preliminary assessment for rapid prototyping purposes and the identification of partners to include in alternative refinement. No alternatives or actions are excluded for potential inclusion within the Restoration Plan.



The team synthesized these results by calculating the total score across all the objectives and uncertainties. This synthesis was conducted first with no weighting (i.e., all objectives are considered to have equal importance), and then by weighting Objectives 1 (improve MM viability over 20 years) and 4 (maximize long-term engagement and support for implementation of MM management) twice as heavily as the other objectives. The team used this weighting because improving the viability of MM populations and engaging partners are relatively more important than the other objectives. The goal of the weighted scoring assessment was to determine if there were significant changes in which alternatives performed well if the primary objectives of the Strategy were given more weight. As before, the goal was not to identify actions for the Restoration Plan, but rather to prioritize which alternatives to use in identifying themes and partners for engagement. In addition, inclusion of the uncertainty scores allowed the team to determine if there were alternatives for which additional information such as background literature or input from SMEs might be beneficial as part of Strategy development, and/or where there were areas of research focus that could be included in the Restoration Plan to strengthen the potential for continued refinement and improvement of the Strategy and Plan's implementation through adaptive management.

### 3.3 Conceptual Modeling

The team identified a subset of eight alternatives to carry through to conceptual model development. The alternatives carried forward included those that scored highly in the weighted rankings and that the team considered representative of potential MM actions when taken together as a set. Conceptual modeling adds value to Strategy development by creating a shared, visual, and structured understanding of complex problems. Its primary purpose, either in visual or written form, is to convey the key components, variables relevant to a problem, and the presumed relationships among them (Jabareen, 2009). Rather than being prescriptive, conceptual models organize thinking about a problem before solutions are determined.

Alternatives carried through to conceptual modeling included:

- decrease dolphin mortality and serious injury associated with menhaden purse seine fisheries;
- decrease dolphin entanglement in otter trawl gear;
- enhance MM stranding network in Louisiana; decrease interactions associated with hook and line fisheries;
- decrease incidences of intentional harm to dolphins associated with fishing;
- decrease dolphin entanglement in skimmer trawl gear;
- decrease feeding associated with recreational fishing stations; and
- develop strategies that mitigate environment-related disease.

For each of these alternatives, the team developed a conceptual model (Figure 3) that included: (1) a draft set of sequenced, high-level components (steps) that would be required to implement the alternative; (2) critical uncertainties that would benefit from being resolved during alternative refinement or as part of the Strategy; (3) NOAA's role in alternative implementation; (4) types of partners that would be needed for implementation; (5) relevant ongoing or prior work that could inform the alternative or support implementation; and (6) the pathway of benefit—how the alternative would directly support MMs. All actions are still under consideration for inclusion in the Restoration Plan regardless of whether they were conceptually modeled or if they were considered as alternatives for the purposes of using SDM rapid prototyping to develop a common framework for the Strategy and to identify key partners.

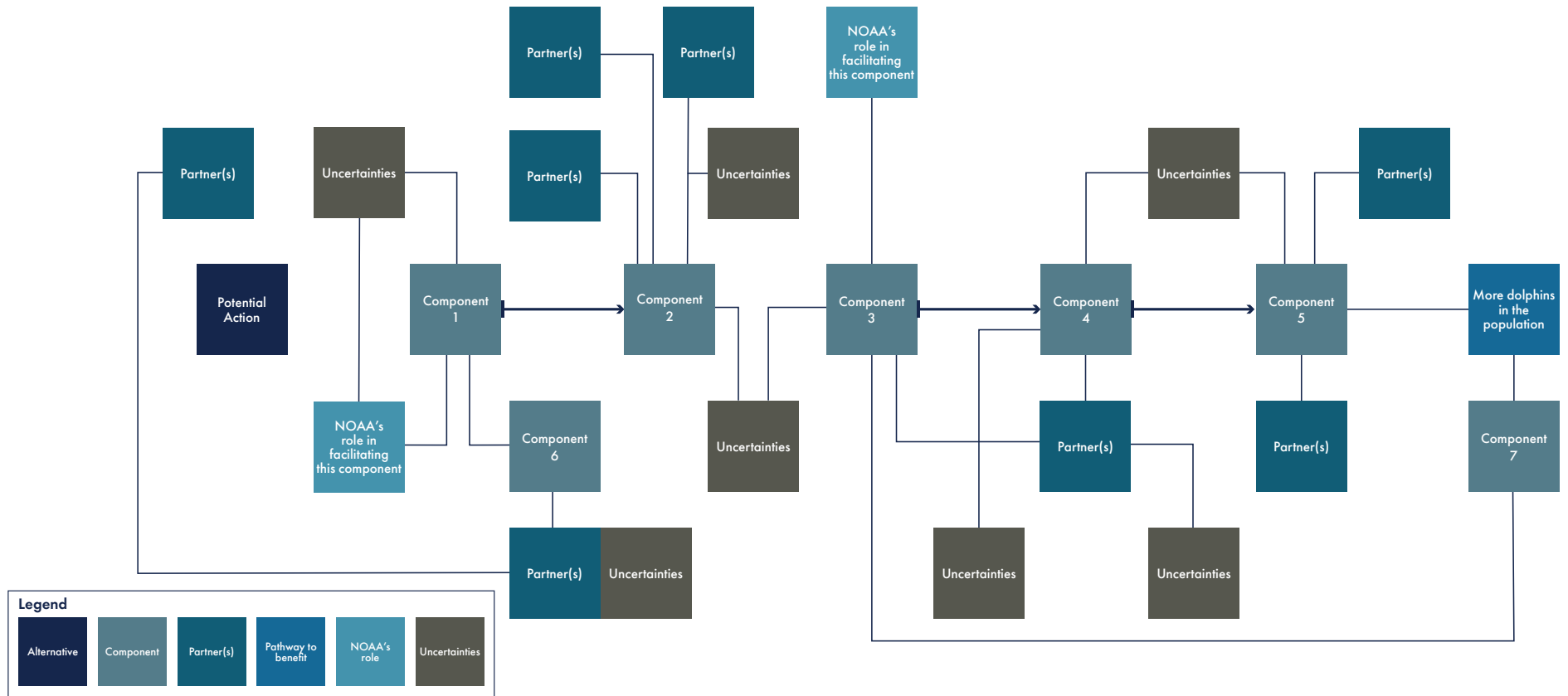


Figure 3. Conceptual model components used to identify the types of partners to engage in refinement of potential actions to inform development of the Strategy.

An example of a conceptual model for decreasing hook and line interactions with bottlenose dolphins is shown in Figure 4, and written conceptual models for each alternative are included in Appendix A.

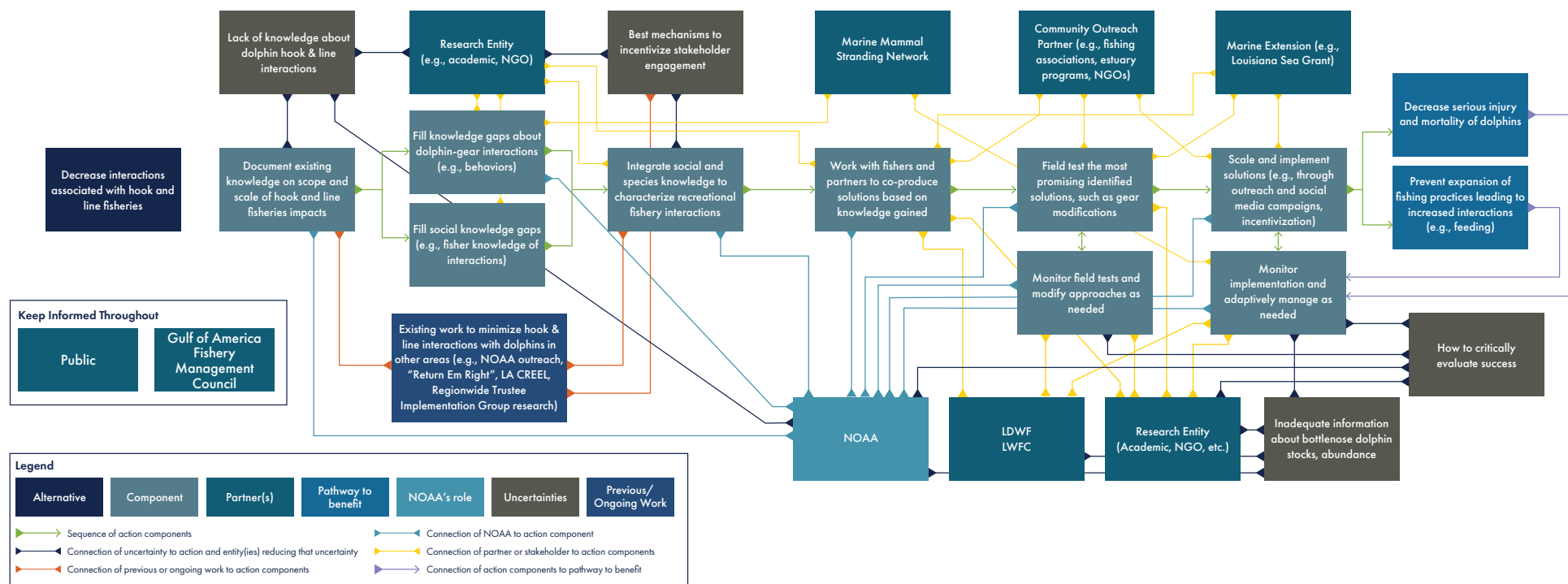


Figure 4. Conceptual model showing the partners, actions, and uncertainties associated with an example action to benefit MMs, in this case, by minimizing negative interactions with hook and line fisheries. Conceptual models were developed for each SDM alternative, which represents a subset of potential actions to include in the Restoration Plan.



Partner types were identified based on their role and potential engagement in implementation of each alternative. For example, a need for research to refine an alternative could be undertaken by an academic or non-profit research organization.

Next, the team reviewed the conceptual models to identify themes that crosscut all of the alternatives and that could form the basis of a programmatic approach to MMs. The identification of themes also helped identify the types of partners to engage for further refinement of the Strategy. For example, each of the alternatives has varying degrees of uncertainty associated with how to implement the alternative, the response of MM populations, or how things might evolve in the future. Research is therefore a crosscutting theme, where the specific type of research—and the most appropriate partners to engage in that research—varies by alternative. Themes identified through this analysis are presented in the next section.

Through the identification of key partners, the team also determined that the same partnership groups appeared in every conceptual model, though their roles vary by alternative. These key partnerships represent five distinct categories: 1) NOAA and other federal agencies; 2) state agencies that have interest in MM and the coastal zone and/or regulatory authority over human activities like fishing that can impact MM, such as the Louisiana Department of Wildlife and Fisheries (LDWF) and National Estuary Programs; 3) academic entities that can conduct research to reduce critical uncertainties in MM management; 4) non-governmental organizations (NGOs) with expertise in MM; and 5) extension programs that can facilitate outreach and local partner engagement, such as Louisiana Sea Grant. The team convened meetings with representatives from each category to introduce the conceptual models and Strategy concepts, seek input, and explore how each organization might play an important role in collaborative restoration for dolphins and how this approach aligns with their existing strategic mission.

Meetings with key partners occurred between August 2025 and January 2026. These meetings were predominantly in person, but in some cases meetings were conducted virtually. Several cross-cutting outcomes emerged across all groups, including: strong support for the priority alternatives, with particularly high interest in addressing hook and line interactions with dolphins; strong support for a collaborative, consortium approach to restore MMs; agreement that this approach aligns well with their organizational missions; and agreement that the Strategy should focus on state-wide coastal waters, not just Barataria Bay.

As the last part of Strategy development, the team met with several organizations that have prior success in establishing long-term MM programs or in identifying and advancing key research to support MM conservation (Appendix B). This engagement identified best practices that could be considered as the Strategy is finalized and implemented.



## 4. STRATEGY THEMES AND FRAMEWORK

The conceptual models developed through the SDM process described above provide a foundation for a broader framework that can be applied to problems beyond those considered in the SDM process. In addition, although the specific details in each model vary by alternative, common themes emerged across all the conceptual models.

These recurring themes included:

- The importance of building partnerships among academics, researchers, extension agents, NGOs, federal, and state agencies;
- The value of early and sustained engagement of partners;
- The importance of NOAA protected resource managers and scientists being engaged throughout the framework;
- The need for state agencies to be engaged at different levels throughout the process depending on the approach;
- The need for collaborative problem-solving and co-production of solutions, particularly for reducing human impacts;
- The value of field-testing and evaluation to refine approaches, in most cases;
- The need for social science and social scientist engagement to integrate information across dolphin experts and local knowledge, as well as to support effective community engagement;
- The importance of being responsive to local Louisiana community needs, experience, and culture; and
- The role of stranding networks as an essential feedback loop for informing, monitoring, and evaluating restoration activities.

These recurrent themes—which were grounded in a preliminary set of specific, high-benefit alternatives initially identified through SME engagement, as well as through synthesizing inputs from experts in establishing long-term, sustainable MM programs (Appendix B)—allow a common framework to be developed for this Strategy that can be applied in the Restoration Plan to any potential restoration action, including those not considered as part of Strategy development.

The framework includes the steps detailed in Table 2. All actions include outreach, training, or engagement as essential for voluntary uptake, followed by monitoring and evaluation of success.



Table 2. Steps for each potential MM restoration action that could potentially be included within the Restoration Plan. The specifics of each step vary by action, but each follows this general framework.

| Framework Step                      | Description/Purpose                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scope and scale of problem          | Briefly characterizes the human interaction or problem to be addressed, including what is known, what additional information is needed, whether relevant data can be compiled, and whether compatible efforts exist in other management or restoration efforts.                                                                                                  |
| Potential partners and stakeholders | Identifies key partners and stakeholders across all stages of restoration, from co-production of outcomes to evaluation of restoration outcomes—including extension, research, training, outreach, and education. Different partners/stakeholders and combinations of those play different roles depending on the approach and stage of restoration.             |
| Critical knowledge gaps             | Identifies missing information relevant to each approach that should be considered throughout all aspects of restoration planning and implementation.                                                                                                                                                                                                            |
| Co-produce solutions                | Describes how each approach will collaboratively engage key partners/stakeholders to identify potential solutions/actions and priorities.                                                                                                                                                                                                                        |
| Field tests/pilots/evaluation       | Characterizes piloting and/or small-scale testing of actions, identified based on co-produced priorities, to evaluate effectiveness and feasibility, and subsequently modify as needed before implementation.                                                                                                                                                    |
| Implementation                      | Describes execution of the most effective action(s) at scale, identified and refined based on outcomes of field testing/piloting outcomes. Implementation includes incorporating relevant strategies such as facilitating uptake of action(s), extension, training, outreach, education, etc.                                                                    |
| Evaluation and adaptive management  | Includes identifying measurable metrics for evaluating effectiveness of actions; monitoring outcomes in collaboration with partners, stakeholders, and academics; and applying adaptive management feedback loops. Adaptive management could address both uptake (how well strategies are being adopted), and success (how well adopted strategies are working). |
| Pathway to benefit                  | Describes the desired restoration outcome for bottlenose dolphins.                                                                                                                                                                                                                                                                                               |

The framework is intentionally transferable. For example, other existing or future activities/priorities not considered in this Strategy through the SDM rapid-prototyping process could be developed and implemented by applying the framework to define the specific steps needed for the action. In that case, actions could be developed by first identifying the scope and scale of the problem, then defining a pathway to benefit, and finally identifying the specific steps associated with that action within the framework to develop a conceptual model that links steps to address the problem through activities that ultimately benefit MMs.



## 5. DISCUSSION AND SYNTHESIS

A significant takeaway from the SDM process used to develop the Strategy and framework are the commonalities shared across potential actions, and what those commonalities suggest about the most effective overall approach for restoring MMs in Louisiana. The same government, academic, extension, NGO, and stranding networks were identified as essential collaborators across the conceptual models for all the potential actions. In addition, many of the core themes identified were consistent with input from entities that have an established history of building successful long-term communities of care for MMs (Appendix B). This consistency of partners, themes, and needs makes a strong case for a programmatic approach to MM restoration in Louisiana, rather than addressing these issues through a series of individual projects. A programmatic approach would support a coordinated, adaptive, long-term sustainable capacity that would be difficult, if not impossible, for individual or short-term projects to achieve on their own.

In addition to the need for and benefits of a programmatic approach to MM restoration in Louisiana, the process used here also identified several practical considerations related to implementation. These include logistical factors such as geographically remote and difficult to access areas; finite local capacity and resources, including time and funding; and uncertainties that must be addressed through targeted research or adaptive management to ensure implementation is effective, robust, and sustainable.

### 5.1 Why A Programmatic Approach To Bottlenose Dolphin Restoration In Louisiana

Restoration activities are frequently implemented as individual projects, each designed, funded, and implemented within its own restoration plan. While this approach can result in localized, project-specific successes, it lacks the scale and continuity required to meet the stated goals for a long-term, sustainable MM restoration in LA, particularly given that MM are a long-lived organism that reproduces slowly. Individual projects are shorter in duration, risk duplicating efforts, create operational silos, and may miss opportunities to leverage data sharing, expertise, and partnerships. A programmatic approach addresses this by coordinating across organizations and expertise, reducing administrative redundancy, maximizing resources, and generating restoration outcomes that are interconnected and cumulative in impact. This kind of connectivity also has a multiplier effect by turning individual restoration activities into a program that builds on itself, generating relationships, institutional knowledge, and capacity that ultimately outlive restoration funding.

In Louisiana, the case for this approach is built on several interconnected components. First, the basic biology of dolphins as long-lived animals requires a long-term commitment. Individual project funding cycles are typically less than 4–5 years, whereas individual animals can live over 40 years. Individual dolphins born after the 2010 DWH oil spill, assuming they survive, have the potential to outlive any single project's funding cycle, and may outlive the careers of the individual project leads and managers. This relatively long life makes a durable, multi-decadal framework necessary.

Second, the same key partner groups emerged across every restoration action examined in this Strategy, regardless of the threat or stressor being addressed. This pattern points more towards a collaborative partnership network in which federal and state agencies, NGOs, academics, dolphin and stranding responders, marine extension agents, and relevant community partners coordinate, co-produce solutions, and share knowledge on a sustained basis.

Third, approaching restoration outcomes through co-production produces better science and better outcomes (Cooke et al., 2025; Norström et al., 2020). Many of the direct threats to bottlenose dolphins in Louisiana are linked to human behavior such as fishing practices, feeding dolphins, and intentional harm, all of which are shaped by attitudes, beliefs, and economic pressures. Co-production generates knowledge among fishing communities, scientists, agencies, and local



partners making that knowledge more credible, building buy-in and ultimately producing solutions that communities will adopt (Wondolleck & Yaffee, 2000; NOAA National Estuarine Research Reserve System Science Collaborative, 2022). This is especially important in high uncertainty situations that require joint action across multiple groups (Scologib & Gallagher, 2021), which is the restoration context this Strategy is operating within.

Fourth, dolphin restoration will require a sustained investment in human capital, which are the people (e.g., researchers, NGOs, agencies, stranding networks, and other key partners) who build relationships, trust, and capacity, and who move restoration funding into restoration actions. Long-term programs like the Sarasota Dolphin Research Program demonstrate that this kind of sustained investment builds the credibility, continuity, consistency, and capacity that restoration work depends on (Gulland, 2021; McHugh et al., 2021). Equally important is the value of cultivating teams, collaborations, and opportunities for sustained engagement across agencies, NGOs, academia, researchers, and community partners rather than concentrating capacity within a single organization.

Finally, programmatic approaches to natural resource restoration generally outperform compilations of individual projects, achieving ecological and administrative outcomes beyond what any single project could achieve on its own (Diefenderfer et al., 2020; Roni et al., 2018). In addition, leveraging outcomes across projects through a programmatic approach can have economic benefits by magnifying and multiplying their individual benefits. This matters for DWH restoration for dolphins in Louisiana since the animals and their threats operate at broad spatial and temporal scales in the state. Programmatic approaches also create capacity that compounds over time resulting in a network of regional expertise that did not exist previously. Thus, this approach contributes to problem solving, implementation, monitoring and adaptive management, and developing regional expertise that no single project could sustain.

The longevity of dolphins, the more than 15-year time-frame for restoration, limited and specialized human capacity needs in LA, crosscutting relevance of the same partner groups, and restoration science literature all indicate that MMs in Louisiana could benefit from investing in a long-term sustainable community of care, which can only be achieved through a programmatic approach to restoration.

## **5.2 Implementation Considerations**

The effectiveness of the Strategy and the Restoration Plan informed by it relies on considering and addressing practical challenges unique to Louisiana. These factors include remote locations, logistical constraints, capacity gaps, competing interests, and uncertainty in MM threats and environmental conditions, all which influence how restoration actions might be implemented. These considerations, when used to inform every phase of restoration, are factors core to implementing an effective Strategy rather than being barriers to success.

### **5.2.1 Geographical and Logistical Considerations**

The coast of Louisiana is a combination of swamps, marshes, wetlands, estuaries, and open water, with many areas being remote, difficult to access, and costly to work in. Stranding response, dolphin research, fisheries interactions, and community engagement all require resources and personnel that can work across these areas. The programmatic approach to restoration should account for the time, cost, coordination, and local expertise needed to maintain a presence across the geographic range of restoration activities. In addition, partnerships with organizations that already have capacity in difficult to reach areas can be leveraged to reduce cost and start-up time.



### **5.2.2 Local Capacity**

The human capacity needed for a programmatic approach to restoration in Louisiana is limited. Currently, that capacity is concentrated in a small number of organizations, such as the existing LAMMSN, that play a central role. Building broader capacity across a partner network as described above is an early, critical need for successful Strategy implementation. In the near term, restoration activities can be scoped to what current capacity can realistically support, with the understanding that expanding capacity will expand what is achievable over time. This approach limits the risk that attempting to implement the full range of activities described in this Strategy before adequate capacity exists could spread resources too thin and undermine the quality, continuity, and credibility this programmatic approach depends on.

### **5.2.3 Focused Funding**

Many funding sources that can support Louisiana MM restoration, including those associated with DWH recovery, have specific requirements dictating what specific activities can be supported, how they are structured, and over what time frame. These requirements are readily aligned to traditional project-based approaches that can be executed over shorter time scales. Most of the activities considered for this Strategy, however, require a sustained community presence, long-term partnerships, iterative engagement, and monitoring and adaptive management. Thus, implementing a successful programmatic approach to dolphin restoration relies on careful consideration of administration requirements, opportunities for non-traditional funding or activity structures, and leveraging opportunities when making restoration decisions.

### **5.2.4 Community Relationships**

Many of the threats described in this Strategy involve conflicts between dolphins and the fishers and/or coastal communities in Louisiana. Commercial and recreational fishing are deeply rooted in Louisiana's culture, in addition to providing significant recreational and economic benefit. Restoration activities that engage these communities as genuine partners are far more likely to be successful. The programmatic approach outlined here, as well as individual restoration activities, will be most effective if implemented with recognition that advancing a shared goal of minimizing dolphin-human conflict can benefit these communities as well as dolphins. Development of a partner network, efforts to engage communities, and co-production that considers this Louisiana context are essential to making long-term sustainable restoration of dolphins possible. Thus, early and ongoing engagement among fishing communities, extension agencies, dolphin and stranding experts, social scientists, government agencies and local partners early in the process is critical to successful implementation.

### **5.2.5 Uncertainty Regarding Threats to Marine Mammals in Louisiana**

The direct threats facing dolphins in Louisiana are generally well known, with the same priority concerns appearing repeatedly across multiple restoration planning documents over the past decade (refer to Section 2.0). However, there are still management-relevant uncertainties in dolphin behavior; the social and human drivers and opportunities of dolphin-human interactions; impacts of diseases that are difficult to detect and monitor; and how these factors impact dolphins. It is also unknown how changing environmental conditions such as extreme weather events, freshwater influx, changes in habitat, and prey availability interact to directly or indirectly magnify known threats, or what additional unknown challenges dolphin populations may encounter in the future.

These unknowns underscore the value of investing in research that reduces uncertainty early in Strategy implementation, while also building monitoring and adaptive management into the programmatic approach. By doing so at the outset,



it preserves the flexibility to adjust and refine activities as new information accumulates over the next 15+ years. The framework identified through this Strategy is designed to be applicable to both known and emerging threats, and to engage partners transparently throughout, treating uncertainty as a shared challenge to address collaboratively rather than a problem that must be solved prior to engagement.

### **5.2.6 Adaptive Management**

Adaptive management is crosscutting within and across restoration activities to ensure efforts are responsive to new information, changing conditions, and emerging threats. The conceptual models developed through this Strategy's SDM process provide a framework including identifying key uncertainties, critical partnerships, and pathways through which restoration activities achieve benefits to dolphins. Through ongoing adaptive management including monitoring data, partner feedback, and other types of metrics, it is expected there will be ongoing adjustments to priorities, methods, and allocations. Thus, nothing is intended to be static over 15+ years, rather it's built to continuously learn and adapt to improve its own effectiveness over time.

### **5.2.7 Coordination Across Organizations**

A programmatic approach to dolphin restoration in Louisiana would bring together federal and state agencies, NGOs, researchers, academic institutions, marine extension agents, stranding experts, and community organizations, each with their own missions, priorities, administrative requirements, and organizational cultures. Coordinating effectively across these groups is itself a significant undertaking, and one that requires deliberate action to become a true partner network rather than a list of participants.

Investment of resources and support for coordination is critical and will enable existing and new efforts focused individually on aspects of MM restoration to come together as a unified, sustained, and holistic effort. This coordination requires engaging people with relationships, credibility, and facilitation skills to build and maintain the network, as well as the sustained funding needed to convene partners and maintain alignment even as restoration activities and roles may evolve through implementation and adaptive management.

### **5.2.8 Phasing Considerations**

The scope and complexity of the multi-partner, programmatic approach outlined for the Strategy necessitate phasing to allow the required components and connections to come online and, ultimately, come together. That phasing can begin with foundational steps required across restoration activities, including establishing a partner network and coordination capacity; making strategic investments in human, agency, and programmatic capacity; and initiating community engagement and relationship-building that long-term dolphin restoration will depend on.

Research to address core unknowns can be initiated in parallel where capacity exists and there are known uncertainties limiting robust restoration decisions. These research efforts can expand over time as capacity comes online and coproduction of implementation plans for restoration activities proceeds and identifies additional needs. The conceptual models developed through this Strategy's SDM process provide additional information on sequencing within each potential activity area, including identifying field testing, piloting, and partner engagement steps that could precede broader implementation. This phased approach provides a practical pathway to a partnership network and a programmatic, integrated approach that is sustainable and effective over the long-term.



## 6. SUMMARY

The DWH oil spill caused significant harm to MM in Louisiana, and, as a result, NRDA funds are dedicated to their restoration as part of compensation for injury. LA TIG, with NOAA as a Trustee, is developing a Restoration Plan to direct those funds to the most beneficial and most effective actions for restoring MM populations in the Louisiana Restoration Area in the context of threats to MM, pathways to benefits, and implementation considerations such as the remote locations where populations are found and existing capacity within the state. The Institute worked with the NOAA Restoration Center to develop this Strategy document, which is intended to inform development of the Restoration Plan.

This Strategy was developed based on SME engagement; information gathering from entities with background and experience in building communities-of-care for MMs; and a rapid-prototyping application of SDM, an objectives-orientated approach to decision-making for complex problems with multiple stakeholders and competing priorities. SMEs provided input on the fundamental objectives of MM restoration as well as potential actions, and entities with experience in building communities-of-care identified lessons learned and best practices relevant to Louisiana. The SDM process identified potential restoration actions for the purposes of developing conceptual models of their implementation. These models were then used to develop a common framework for restoration actions and to identify key themes and partners important for successfully implementing MM restoration in Louisiana.

The common framework presented in this Strategy—which can be used to inform the Restoration Plan and the development, evaluation, and prioritization of potential restoration actions—includes defining the scope and scale of the specific problem, identifying a pathway to benefit MMs, and working through a structured set of steps that could link the problem through a potential solution resulting in the pathway to benefit. These steps include: identifying potential partners and stakeholders; determining critical knowledge gaps; co-producing solutions; field testing and piloting actions to evaluate their effectiveness; implementing actions at scale; and evaluating and adaptively managing. This framework is intentionally transferable and can be applied to any potential restoration action, including those not explicitly identified in this Strategy.

This Strategy also identifies recurrent themes relevant to Restoration Plan development, including the importance or partnerships among federal and state agencies, academics, NGOs, extension programs, and stranding networks; the value of early and sustained partner engagement; the importance of NOAA managers and scientists being engaged throughout the framework; the need for state agencies to be engaged at different levels depending on the approach; the need for co-production of solutions particularly for addressing human-caused threats; the role of social science in integrating local knowledge and supporting community engagement and integrating that with dolphin expertise and knowledge; the value of field-testing and evaluation to refine approaches; the importance of being responsive to Louisiana local needs and expertise; and the importance of stranding networks as a feedback mechanism for informing, monitoring, and adaptively managing restoration activities.

Lastly—and perhaps most importantly—this Strategy highlights the vital importance of a programmatic approach to MM restoration in Louisiana, the partnerships that are foundational for its success, and the unique challenges and opportunities of MMs in Louisiana that must be considered. The effectiveness of MM restoration is grounded in implementation decisions that address practical factors such as remote locations, logistical constraints, and the cultural and economic fishing heritage of Louisiana. Unlike individual projects, which may be limited in scope and benefit, a Louisiana-centric, programmatic approach—grounded in partnerships and investment in human capacity—can build a sustainable structure for benefiting MMs long into the future.



## 7. REFERENCES

- Barcenas-De La Cruz, D., DeRango, E., Johnson, S. P., & Simeone, C. A. (2018). Evidence of anthropogenic trauma in marine mammals stranded along the central California coast, 2003–2015. *Marine Mammal Science*, 34(2), 330–346. <https://doi.org/10.1111/mms.12457>
- Bearzi, G., Bonizzoni, S., & Gonzalvo, J. (2011). Dolphins and coastal fisheries within a marine protected area: Mismatch between dolphin occurrence and reported depredation. *Aquatic Conservation Marine and Freshwater Ecosystems*, 21(3). <https://doi.org/DOI:10.1002/aqc.1179>
- Cooke, S. J., Bett, N. N., Hinch, S. G., Adolph, B., Hasler, C. T., Howell, B. E., Schoen, A. N., Mullen, E. J., Fangue, N. A., Todgham, A. E., Cheung, M. J., Johnson, R. C., Sze-Tung Olstad, R., Sisk, M., Sisk, C., Franklin, C. E., Irwin, R. C., Irwin, T. R., Lewandrowski, W., ... Fuller, A. (2025). Co-production and conservation physiology: Outcomes, challenges and opportunities arising from reflections on diverse co-produced projects. *Conservation Physiology*, 13(1). <https://doi.org/10.1093/conphys/coaf049>
- Dalyander, P. S., Henkel, J., & Littman, A. (2024). Facilitated workshop on beneficial use of dredged material at MacDill Air Force Base (p. 81). Water Institute. Dalyander, P. S., Henkel, J., & Littman, A. (2024). Facilitated workshop on beneficial use of dredged material at MacDill Air Force Base (p. 81). Water Institute.
- Dalyander, P. S., Meyers, M., Mattsson, B., Steyer, G., Godsey, E., McDonald, J., Byrnes, M., & Ford, M. (2016). Use of structured decision-making to explicitly incorporate environmental process understanding in management of coastal restoration projects: Case study on barrier islands of the northern Gulf of Mexico. *Journal of Environmental Management*, 183(3), 497–509. <https://doi.org/10.1016/j.jenvman.2016.08.078>
- Deepwater Horizon Natural Resource Damage Assessment Trustees. (2016). Deepwater Horizon oil spill final programmatic damage assessment and restoration plan and final programmatic environmental impact statement. Chapter 8: Trustee responses to public comments on the draft PDARP/ PIES. Deepwater Horizon Natural Resource Damage Assessment Trustees. <http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan>
- Diefenderfer, H. L., Steyer, G. D., Harwell, M. C., LoSchiavo, A. J., Neckles, H. A., Burdick, D. M., Johnson, G. E., Buenau, K. E., Trujillo, E., Callaway, J. C., Thom, R. M., Ganju, N. K., & Twilley, R. R. (2020). Applying cumulative effects to strategically advance large-scale ecosystem restoration. *Frontiers in Ecology and the Environment*, 19(2), 108–117. <https://doi.org/10.1002/fee.2274>
- DWH NRDA Trustees. (2016a). Deepwater Horizon oil spill programmatic damage assessment and restoration plan/ programmatic environmental impact statement. Chapter 4: Injury to natural resources. Deepwater Horizon Natural Resource Damage Assessment Trustees. <https://www.gulfspillrestoration.noaa.gov/media/document/chapter-4injurytonaturalresources508pdf>
- DWH NRDA Trustees. (2016b). Deepwater Horizon oil spill programmatic damage assessment and restoration plan/ programmatic environmental impact statement. Chapter 5: Restoring natural resources. Deepwater Horizon Natural Resource Damage Assessment Trustees. <https://www.gulfspillrestoration.noaa.gov/media/document/chapter-5restoring-natural-resources508pdf>
- DWH NRDA Trustees. (2017). Deepwater Horizon Oil Spill Natural Resource Damage Assessment: Strategic framework for marine mammal restoration activities (p. 66) [Strategic Framework]. National Oceanic & Atmospheric Administration. <http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan>



- Gulland, F. M. D. (2021). How to work on a non-endangered species and contribute to Cetacean conservation: An example by the Sarasota Dolphin Research Program. *Frontiers in Marine Science, Marine Conservation and Sustainability*, 8. <https://doi.org/10.3389/fmars.2021.648957>
- Hammond, J., Keeney, R., & Raiffa, H. (1999). *Smart choices: A practical guide to making better decisions*. Howard Business School Press.
- Hataway, D., & Foster, D. (2015). Investigating dolphin interactions with skimmer trawls using the DIDSON aboard the F/V Seaweed 2000 (p. 15). National Marine Fisheries Service; Southeast Fisheries Science Center; Pascagoula Laboratory Engineering and Harvesting Systems Branch. <https://www.fws.gov/doiddata/dwh-ar-documents/4722/DWH-ARZ009935.pdf>
- Hayes, S. A., Josephson, E., Maze-Foley, K., Rosel, P. E., & McCordic, J. (2024). U.S. Atlantic and Gulf of Mexico marine mammal stock assessments 2023 (NOAA Technical Memorandum NMFS-NE-321; p. 375). US Department of Commerce; National Oceanic and Atmospheric Administration; National Marine Fisheries Service; Northeast Fisheries Science Center. <https://repository.library.noaa.gov/view/noaa/66187>
- Jabareen, Y. (2009). Building a conceptual framework: Philosophy, definitions, and procedure. *International Journal of Qualitative Methods*, 8, 49–62.
- Keeney, R. L. (2004). Making better decision makers. *Decision Analysis*, 1(4), 193–204. <https://doi.org/10.1287/deca.1040.0009>
- LA TIG. (2025a). Characterization of human-caused threats to bottlenose dolphins in Louisiana (Deliverable 4 in support of Monitoring Approaches for Bottlenose Dolphin Restoration in Louisiana; p. 63). LA TIG. <https://pub-data.diver.orr.noaa.gov/restoration/Bottlenose%20Dolphin%20Characterization%20of%20Human-Caused%20Threats.pdf>
- LA TIG. (2025b). Evaluating the threats of disease, contaminants, and environmental hazards on Louisiana dolphin health: A literature review, conceptual model, and health assessment plan (Executive Summary Deliverable 12 in support of Monitoring Approaches for Bottlenose Dolphin Restoration in Louisiana; p. 79). LA TIG. <https://pub-data.diver.orr.noaa.gov/restoration/Bottlenose%20Dolphin%20Freshwater%20Assessment%20and%20Strategy%20Report.pdf>
- LA TIG. (2025c). Freshwater response, scientific/impact assessment and decision-making strategy report (Deliverable 6 in support of Monitoring Approaches for Bottlenose Dolphin Restoration in Louisiana; p. 25.). LA TIG.
- LA TIG. (2025d). Monitoring plan for common bottlenose dolphin stocks across Louisiana basins and nearshore coastal waters (Deliverable 3 in support of Monitoring Approaches for Common Bottlenose Dolphin Restoration in Louisiana; p. 39). LA TIG. <https://pub-data.diver.orr.noaa.gov/restoration/Bottlenose%20Dolphin%20Monitoring%20Plan%20Across%20Louisiana%20Basins%20and%20Nearshore%20Waters.pdf>
- Long, K. J., DeAngelis, M. L., Engleby, L. K., Fauquir, D. A., Johnson, A. J., Kraus, S. D., & Northridge, S. P. (2015). Marine mammal non-lethal deterrents: Summary of the technical expert workshop on marine mammal non-lethal deterrents, 10-12 February 2015, Seattle, Washington (NOAA Technical Memorandum NMFS-OPR-50; p. 44). US Department of Commerce; National Oceanic and Atmospheric Administration; National Marine Fisheries Service.



- Marine Mammal Commission. (n.d.). Fisheries interactions with marine mammals. Priority Topics. Retrieved <https://www.mmc.gov/priority-topics/fisheries-interactions-with-marine-mammals/>
- Marine Mammal Commission. (2024). Marine mammal health surveillance workshop report (p. 32) [Final Report]. Marine Mammal Commission. <https://www.mmc.gov/wp-content/uploads/Marine-Mammal-Health-Surveillance-Workshop-Report.pdf>
- McHugh, K. A., Barleycorn, A. A., Allen, J. B., Bassos-Hull, K., Lovewell, G., Boyd, D., Panike, A., Crush, C., Fauquier, D., Mase, B., Lacy, R. C., Greenfield, M. R., Rubenstein, D. I., Weaver, A., Stone, A., Oliver, L., Morse, K., & Wells, R. S. (2021). Staying alive: Long-term success of bottlenose dolphin interventions in southwest Florida. *Frontiers in Marine Science, Marine Megafauna*, 7. <https://doi.org/10.3389/fmars.2020.624729>
- Minor, A., Cowan, J., Carruthers, T., Mallindine, J., & Weaver, A. (2025). Louisiana Marine Mammal Restoration Strategy: Task 1.2 subject matter experts virtual working sessions (p. 37). The Water Institute. Prepared for the National Oceanic and Atmospheric Administration (NOAA).
- Minor, A., Cowan, J., Dausman, A., Carruthers, T., & Mallindine, J. (2025). Louisiana Marine Mammal Restoration Strategy: Task 1.1 Literature Review (p. 6). The Water Institute. Prepared for the National Oceanic and Atmospheric Administration (NOAA).
- MS TIG. (2025). Reduction of marine mammal fishery interactions through trawl technique and component material improvements. Gulf Spill Restoration. <https://www.gulfspillrestoration.noaa.gov/project?id=311>
- NMFS. (1994). Report to Congress on results of feeding wild dolphins, 1989-1994 (p. 84). NMFS Office of Protected Resources. <https://repository.library.noaa.gov/view/noaa/16196>
- NMFS. (2022). Common bottlenose dolphin (*Tursiops truncatus*): Northern Gulf of Mexico bay, sound, and estuary stocks [Stock Assessment]. US Department of Commerce; NOAA Fisheries.
- NOAA. (2021). Sea turtles, dolphins, and whales—10 years after the Deepwater Horizon oil spill. NOAA Fisheries. <https://www.fisheries.noaa.gov/national/marine-life-distress/sea-turtles-dolphins-and-whales-10-years-after-deepwater-horizon-oil>
- NOAA. (2022). Mississippi Trustee Implementation Group releases third restoration plan. Gulf Spill Restoration. <https://www.gulfspillrestoration.noaa.gov/2022/06/mississippi-trustee-implementation-group-releases-third-restoration-plan>
- NOAA. (2025). Monitoring approaches for bottlenose dolphin restoration in Louisiana. Gulf Spill Restoration. <https://gulfspillrestoration.noaa.gov/project?id=301>
- NOAA Fisheries. (2025a). Gulf of Mexico Menhaden Purse Seine Fishery—MMPA List of Fisheries. Marine Mammal Protection. <https://www.fisheries.noaa.gov/national/marine-mammal-protection/gulf-mexico-menhaden-purse-seine-fishery-mmpa-list-fisheries>
- NOAA Fisheries. (2025b). Marine Mammal Health Monitoring and Analysis Platform (Health MAP). Marine Life in Distress. <https://www.fisheries.noaa.gov/national/marine-life-distress/marine-mammal-health-monitoring-and-analysis-platform-health-map>
- NOAA Fisheries. (2026). Marine mammal unusual mortality events. Marine Mammal Protection. <https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-unusual-mortality-events>



- NOAA National Estuarine Research Reserve System Science Collaborative. (2022). Guide to collaborative science. NOAA National Estuarine Research Reserve System Science Collaborative. [nerrsciencecollaborative.org/guide](https://nerrsciencecollaborative.org/guide)
- Norström, A. V., Cvitanovic, C., Löf, M. F., West, S., Wyborn, C., Balvanera, P., Bednarek, A. T., Bennet, E. M., Biggs, R., de Bremond, A., Campbell, B. M., Canadell, J. G., Carpenter, S. R., Folke, C., Fulton, E. A., Gaffney, O., Gelcich, S., Jouffray, J.-B., Leach, M., ... Österblom, H. (2020). Principles for knowledge co-production in sustainability research. *Nature Sustainability, Perspective*, 3, 182–190.
- Open Ocean TIG. (2023). Monitoring and adaptive management plan for Deepwater Horizon NRDA project: Reducing impacts to cetaceans during disasters by improving response activities (p. 7). Open Ocean TIG. [https://pub-data.diver.orr.noaa.gov/restoration/OO\\_TIG\\_RP2EA\\_DisasterResponse\\_MAMplan.pdf](https://pub-data.diver.orr.noaa.gov/restoration/OO_TIG_RP2EA_DisasterResponse_MAMplan.pdf)
- Open Ocean TIG. (2024). Final monitoring and adaptive management report: Developing methods to observe sea turtle interactions in the Gulf of Mexico Menhaden Purse Seine Fishery (Project #220). Open Ocean TIG.
- Powell, J. R., & Wells, R. S. (2011). Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *Marine Mammal Science*, 27(1), 111–129. <https://doi.org/DOI: 10.1111/j.1748-7692.2010.00401.x>
- Regionwide TIG. (2022). Monitoring and adaptive management plan: Enhance marine mammal stranding network diagnostic capabilities and consistency across the Gulf of Mexico (p. 16). DWH Regionwide TIG. <https://pub-data.diver.orr.noaa.gov/restoration/Enhance%20Marine%20Mammal%20Stranding%20Network%20%20Diagnostic%20Capabilities%20and%20Consistency%20across%20the%20Gulf%20of%20Mexico%20MAM%20Plan.pdf>
- Regionwide TIG. (2025a). Reducing impacts to dolphins from hook-and-line gear and provisioning through fishery surveys, social science, and collaboration. Gulf Spill Restoration. <https://www.gulfspillrestoration.noaa.gov/project?id=340>
- Regionwide TIG. (2025b). Voluntary modifications to commercial shrimp lazy lines to reduce dolphin entanglements. Gulf Spill Restoration. <https://www.gulfspillrestoration.noaa.gov/project?id=341>
- Roni, P., Aberg, U., & Weber, C. (2018). A review of approaches for monitoring the effectiveness of regional river habitat restoration program. *North American Journal of Fisheries Management*, 38(5), 1170–1186.
- Schwacke, L. H., Garrison, L. P., Rosel, P. E., McDonald, T., Hornsby, F., Litz, J., Thomas, L., Mullin, K. D., Balmer, B. C., Booth, C. G., Hohn, A. A., Kellar, N. M., Speakman, T. R., Wells, R. S., & Zolman, E. S. (2015). Models and analyses for the quantification of injury to Gulf of Mexico cetaceans from the Deepwater Horizon oil spill [DWH NRDA Marine Mammal Technical Working Group Report]. Prepared by the Deepwater Horizon Marine Mammal Injury Quantification Team. <https://www.fws.gov/doiddata/dwh-ar-documents/876/DWH-AR0105866.pdf>
- Schwacke, L. H., Thomas, L., Wells, R. S., McFee, W. E., Hohn, A. A., Mullin, K. D., Zolman, E. S., Quigley, B. M., Rowles, T. K., & Schwacke, J. H. (2017). Quantifying injury to common bottlenose dolphins from the Deepwater Horizon oil spill using an age-, sex- and class-structured population model. *Endangered Species Research*, 33. <https://doi.org/10.3354/esr00777>



- Scologib, A., & Gallagher, L. (2021). Understanding, analysing and addressing conflicts in co-production. In E. Loeffler & T. Bovaird (Eds.), *The Palgrave Handbook of Co-Production of Public Services and Outcomes*. Palgrave Macmillan, Cham. [https://doi.org/10.1007/978-3-030-53705-0\\_32](https://doi.org/10.1007/978-3-030-53705-0_32)
- Smith, C. R., Gomez, F. M., Ivančić, M., Colegrove, K. M., Takeshita, R., Townsend, F. I., Zolman, E. S., Morey, J. S., Cendejas, V., Meegan, J. M., Musser, W., Speakman, T. R., Barratclough, A., Wells, R. S., Schwacke, L. H., & C. R. Smith. (2022). Poor pulmonary health in Barataria Bay dolphins in the eight years following the Deepwater Horizon oil spill. *Frontiers in Marine Science, Marine Conservation and Sustainability*, 9. <https://doi.org/10.3389/fmars.2022.975006>
- Soldevilla, M. S., Garrison, L. P., Scott-Denton, E., & Hart, R. A. (2016). Estimated bycatch mortality of marine mammals in the Gulf of Mexico shrimp otter trawl fishery during 2012 to 2014 (NOAA Technical Memorandum NMFS-SEFSC-697). US Department of Commerce; National Oceanic and Atmospheric Administration; National Marine Fisheries Service; Southeast Fisheries Science Center. <https://www.fws.gov/doiddata/dwh-ar-documents/4722/DWH-ARZ009946.pdf>
- Southeast Fisheries Science Center. (2026, March 10). NOAA Fisheries report reveals dire state of Gulf shrimp fishery. NOAA Fisheries. <https://www.fisheries.noaa.gov/feature-story/noaa-fisheries-report-reveals-dire-state-gulf-shrimp-fishery>
- Venn-Watson, S., Colegrove, K. M., Litz, J., Kinsel, M., Terio, K., Saliki, J., Fire, S., Carmichael, R., Chevis, C., Hatchett, W., Pitchford, J., Tumlin, M., Field, C., Smith, S., Ewing, R., Fauquier, D., Lovewell, G., Whitehead, H., Rotstein, D., ... Rowles, T. (2015). Adrenal gland and lung lesions in Gulf of Mexico Bottlenose Dolphins (*Tursiops truncatus*) found dead following the Deepwater Horizon oil spill. *PLoS ONE*, 10(5). <https://doi.org/10.1371/journal.pone.0126538>
- Wells, R. S., Hohn, A. A., Scott, M. D., Sweeney, J. C., Townsend, Jr., F. I., Allen, J. B., Barleycorn, A. A., McHugh, K. A., Bassos-Hull, K., Lovewell, G. N., Duffield, D. A., Smith, C. R., & Irvine, A. B. (2025). Life history, reproductive, and demographic parameters for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *Frontiers in Marine Science, Marine Megafauna*, 12. <https://doi.org/doi.org/10.3389/fmars.2025.1531528>
- Wells, R. S., & Scott, M. D. (2009). Common bottlenose dolphin: *Tursiops truncatus*. In W. F. Perrin, B. Würsig, & J. G. M. Thewissen (Eds.), *Encyclopedia of Marine Mammals* (Second, pp. 249–255). Academic Press. <https://doi.org/10.1016/B978-0-12-373553-9.00062-6>
- Wondolleck, J. M., & Yaffee, S. L. (2000). *Making collaboration work: Lessons from innovation in natural resource management*. Island Press.
- Zolman, E. S., Speakman, T., Morey, J., L. Hart, Smith, C. R., McFee, W., Schwacke, L., & Takeshita, R. (In press). Insult to injury: Population impacts of sub-lethal entanglement and vessel strikes of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Basin, Louisiana, 2011–2013. *Marine Mammal Science*.



## APPENDIX A. Written Conceptual Models for Potential Marine Mammal Actions

Conceptual models were developed for a set of potential MM actions to facilitate the team's development of a common framework for the Strategy and to identify the types of partners to engage in a long-term community of care for dolphins in Louisiana. These activities were identified through a rapid prototyping application of SDM (refer to Section 3.0) to identify alternative MM actions. These actions are examples only, and the Strategy may include additional actions or a modified list. Written versions of the conceptual models are provided below and describe the specific steps within the common framework developed for the Strategy (refer to Section 4.0).

### A.1 Decrease Entanglement in Shrimp Otter Trawl Gear

#### *1. Scope and scale of problem*

The shrimp fishery in Louisiana targets two main species: brown and white shrimp. The most common types of otter trawl gear used offshore, and in some cases onshore, already incorporate turtle exclusion and bycatch reduction devices to mitigate sea turtle bycatch. Though bycatch of dolphins is known to occur (Soldevilla et al., 2016), there are currently no efforts targeted to reduce bycatch of dolphins in Louisiana. There are ongoing and complementary restoration efforts, including Regionwide Bottlenose dolphin and Texas City Y (TCY), applying similar advancements in gear modifications. The first step of this action would be a comprehensive assessment of shrimp fishery and dolphin bycatch in Louisiana state waters as well as lessons learned that could be applied to Louisiana.

#### *2. Potential partners and stakeholders*

This action would require multiple stakeholders working collaboratively with fishers and partners to co-produce solutions. Partnership opportunities could include, but are not limited to, working with academics, gear experts, NGOs, marine extensions, commercial fishers, dolphin researchers, resource managers, and the Louisiana MM stranding network. NOAA also has multiple potential roles to play throughout all aspects of the project, including management and oversight, bycatch analyses, and gear testing.

#### *3. Critical knowledge gaps*

Examples of uncertainties related to this action include lack of adequate knowledge about dolphin stocks and Louisiana inshore fishery distribution; fishers' interest level and incentives for engagement; potential language or cultural barriers; capacity and experience for gear research/testing; and limited observer coverage to measure effectiveness. There is also a lack of knowledge about the motivation of shrimpers to pursue solutions, their willingness to engage, or how to engage this community effectively. Lastly, the shrimp fishing industry in Louisiana is facing significant economic challenges due to high fuel costs and competition with imported shrimp, which creates uncertainty in the effectiveness of this potential action in benefiting MMs (Southeast Fisheries Science Center, 2026).

#### *4. Co-produce solutions*

Some of the key partners needed to co-produce specific solutions under this action could include but not be limited to shrimpers, gear and dolphin experts, and community engagement partners in Louisiana. This group could work collaboratively to identify and explore the feasibility and effectiveness of different approaches that can, for example, reduce risk of dolphin entanglement in lazy lines. This action could also likely benefit from involving a fishery liaison and marine extension to engage fishing community, and potentially social science researchers on how to facilitate group engagement, communicate results, and support uptake of solutions by the fisher community.



## **5. Field tests/pilots/evaluation**

Some aspects of this potential action that could require field testing and evaluation include balancing effectiveness in reducing harm to dolphins with minimizing impact to fishing activity, as well as identifying what approaches are most likely to be voluntarily used by the fishery. The field test step could therefore be comprised of testing and evaluating the feasibility and success of potential approaches identified in Step 4; working with fishers to incorporate, monitor, and evaluate tested approaches; and monitoring and assessing solution effectiveness in reducing injury and mortality to dolphins. Decisions on field testing and ultimately implementation would necessarily include assessing the likelihood of benefit in the context of the overall trajectory of shrimp fishing in Louisiana.

## **6. Implementation**

Effective solutions for addressing MM harm through shrimp otter trawl gear interaction could be identified through field testing based on feasibility, likelihood of uptake by the shrimping community, and effectiveness in reducing harm to dolphins. Once identified, solutions could be implemented through activities that encourage uptake such as outreach, education, and training. In addition, NOAA and the community of care could explore incentives for encouraging use of identified best practices across the shrimp fishery and to provide training and/or resources to encourage incorporation of lazy line modification.

## **7. Evaluation and adaptive management**

The evaluation and adaptive management phase could include NOAA collaborating with researchers, state agencies such as the Louisiana Department of Wildlife and Fisheries, and fisher community engagement partners to monitor, evaluate, and adaptively manage the implementation of this action. For example, metrics of success could include evaluating the percentage of the shrimp fishery that voluntarily incorporates gear modifications. If this percentage is lower than desired, surveys could be used to determine if the issue was awareness or an issue with gear itself, and the outreach efforts, incentivization campaigns, or gear could be modified depending on the results. Other metrics such as assessing bycatch or benefits to dolphins could also be included.

## **8. Pathway to benefit**

The pathway to benefit for this potential action is reducing serious injury and mortality to dolphins in shrimp otter trawl gear if there are fewer dolphin-gear interactions and if the gear itself limits entanglement.

# **A.2 Decrease Interactions with Skimmer Trawl Gear**

## **1. Scope and scale of problem**

The Gulf skimmer trawl fishery is a shallow water nearshore fishery that uses large nets to push through the water column, just above the seafloor. While there is some minor risk to dolphins getting entangled or harmed by the gear, the more pervasive problem is dolphins ripping holes in the fishing nets themselves. Dolphins damage gear and lead to loss of catch with economic impacts for fishers, who then intentionally harm dolphins (e.g., shoot them) as a deterrent (Hataway & Foster, 2015). There has been prior interest in reducing this pathway to harm. A DWH restoration project approved to address this issue in state waters of Mississippi has been delayed (NOAA, 2022). In addition, NOAA researchers have conducted extensive research with skimmer trawl fishers to document interactions (e.g., use of Dual-frequency



Identification SONar, DIDSON) and test potential gear modifications (e.g., use of high strength materials such as Ultra-High-Molecular-Weight PolyEthylene, UHMWPE, in nets; Hataway & Foster, 2015); however, this work is not presently active due to lack of funding.

## **2. Potential partners and stakeholders**

Partnership and engagement opportunities could include working with skimmer trawl fishers in Louisiana, local gear/net makers, researchers, academics, marine extensions, resource managers, and the stranding network. NOAA could play multiple roles throughout all aspects of this action, including oversight, bycatch analyses, and gear testing. A fishery liaison could also be included as a mechanism to engage and communicate with industry.

## **3. Critical knowledge gaps**

Uncertainties associated with this potential action include the type and extent of novel gear expertise in Louisiana and the availability of potential gear experts to work with fishers in testing and evaluating new or modified gear; the effectiveness and feasibility of implementing previously identified gear modifications, such as UHMWPE; and inadequate knowledge about bottlenose dolphin behavior and how those factors influence the number of skimmer trawl fisher-dolphin interactions or the effectiveness of potential solutions.

## **4. Co-produced solutions**

The key partners necessary to convene to co-produce solutions under this action could include skimmer trawlers, gear and dolphin experts, academics, resource managers, and other relevant partners in Louisiana. This group could work collaboratively to identify and explore the feasibility of gear modifications to reduce damage from dolphin interactions and/or to reduce the number of interactions.

## **5. Field tests/pilots/evaluation**

Some important aspects of this potential action are likely to require field testing and evaluation, including assessing previously identified gear modifications and/or new approaches (e.g., alternate net materials, covers, etc.) that emerge from Step 4; the effectiveness of the gear in preventing damage from dolphins and the feasibility; and the potential for uptake. The field test step could therefore be comprised of testing and evaluating the feasibility and success of potential approaches; working with fishers to incorporate, monitor, and evaluate tested approaches; and monitoring and assessing solution effectiveness in reducing dolphin interactions with this fisher community.

## **6. Implementation**

If field testing shows that identified solutions are effective, implementation could include activities such as convening gear experts with willing skimmer trawl fishers and dolphin behavior experts to pilot new gear modifications; developing and implementing a plan for uptake of voluntary gear modifications; and providing training and outreach to skimmer trawl fishers. There is the potential that the fishing community could be particularly amenable to this action given that dolphins currently have a negative impact on this community through gear damage, which could be reduced.



## **7. Evaluation and adaptive management**

This step could include collaborations among academics, marine extensions, fishers, and dolphin experts on monitoring, evaluation, and adaptive management of new types of gear. For example, metrics of success could include evaluating the percentage of the skimmer trawl fishery that voluntarily incorporates gear modifications and the percent reduction in dolphin injuries or deaths from gunshot wounds. If these metrics are lower than desired, surveys could be used to determine if the issue was awareness or an issue with the gear itself, and the outreach efforts, incentivization campaigns, or gear could be modified depending on the results. Other metrics such as assessing benefits to dolphins or their behavior could also be included.

## **8. Pathway to benefit**

The pathway to benefit for this action is that it could reduce the number of mortalities and serious injuries associated with the skimmer trawl fishery, which are typically related to retaliation for gear damage.

### **A.3 Decrease Mortality and Serious Injury in Menhaden Fishery**

#### **1. Scope and scale of problem**

Historical and recent data has documented bycatch of bottlenose dolphins in the menhaden commercial fishery in Louisiana, and therefore the pathway to harm is relatively well understood compared to other issues (NMFS, 2022; NOAA Fisheries, 2025a; LA TIG, 2025a). More recently, there were 44 documented dolphin interactions in the menhaden fishery in 2022–2023 (Open Ocean TIG, 2024). The DWH Open Ocean Sea Turtle project tested methods to observe the Gulf of America Menhaden Fishery and collected data on the nature and extent of interactions with sea turtles and dolphins. While there were few sea turtle interactions, a high number of dolphin interactions, including serious injuries and mortalities, were documented. There is also ongoing work to address this issue including NOAA, the menhaden fishery, and partners exploring potential solutions such as backing down, or other practices. In addition, LDWF has supported various studies as part of its role in managing aspects of different fisheries in state waters.

#### **2. Potential partners and stakeholders**

Partnership opportunities could include working with the menhaden fishing industry, such as captains and crews; resource managers, such as LDWF and NOAA; NGOs, such as the Marine Stewardship Council or the Louisiana Commercial Fisheries Coalition, LLC; dolphin and fishery researchers, such as academics, marine extensions, and the stranding network. NOAA has multiple potential roles to play throughout all aspects of the project, including oversight, bycatch analyses, establishing best practices, and monitoring.

#### **3. Critical knowledge gaps**

Uncertainties associated with this potential action include the level of engagement of the menhaden fishery owners, captains, crew and potential partners; applicability of best practices used in similar situations (e.g., for reducing bycatch by the Eastern Tropical Pacific purse seine fishing industry) are applicable and transferrable to Louisiana; whether potential best practices would be implemented across the fishery on a sustained basis; the viability of video monitoring as a feasible tool for evaluating success; and lack of knowledge about the impact of bycatch on MM stocks, including an inadequate knowledge about bottlenose dolphin abundance and behavior.



#### **4. Co-produced solutions**

The key partners necessary to co-produce solutions under this action could include dolphin behavior experts, menhaden/purse seine fishery experts, academics, federal and state agencies, and menhaden fishery representatives to explore potential voluntary best practices that reduce bycatch and to select the most promising best practices to test. A fishery liaison could also be included as a mechanism to engage and communicate with industry.

#### **5. Field tests/pilots/evaluation**

Some important aspects of this potential action likely to require field testing and evaluation include assessing best practices that emerge from Step 4, including the effectiveness in reducing bycatch or injury and the feasibility and potential for uptake. The field test step could therefore be comprised of testing and evaluating the feasibility and success of potential approaches; working with fishers to incorporate, monitor, and evaluate tested approaches; and monitoring and assessing solution effectiveness.

#### **6. Implementation**

If field testing supports that identified solutions are effective, implementation could include activities such as broader outreach to the menhaden fishery owners, captains, and crew for widespread uptake of best practices and/or gear modifications.

#### **7. Evaluation and adaptive management**

This step could include collaborations among academics, marine extensions, owners, fishers, and dolphin experts on monitoring (e.g., through video monitoring), evaluation, and adaptive manage solutions. For example, metrics of success could include evaluating the percentage of menhaden fleet that incorporates identified best practices. If this percentage is lower than desired, the menhaden fishery owners and/or captains could be engaged to identify what specific aspects of the identified practice are impractical to implement and modify based on the feedback. Monitoring dolphin bycatch through video monitoring and dolphin abundance and/or behavior are metrics that could also evaluate success.

#### **8. Pathway to benefit**

The pathway to benefit for this potential action could be that fewer dolphins are killed and seriously injured by menhaden purse seine fishing.

### **A.4 Decrease Interactions with Hook and Line Fisheries**

#### **1. Scope and scale of problem**

Dolphin interactions with hook and line fisheries in Louisiana are a well-known threat (see LA TIG, 2025a). Twenty-eight percent of stranded dolphins with evidence of fishery interactions were from hook and line, and 46% of Barataria Bay dolphins have evidence of scarring from hook and line gear (Zolman et al., In press). There is an ongoing Regionwide restoration project focused on understanding dolphin/hook and line interactions across the northern Gulf. The DWH restoration project “Return Em Right” (<https://returnemright.org/>) and the Louisiana CREEL program (<https://www.wlf.louisiana.gov/page/lacreel>) are also focused on best practices for hook and line fishers and reducing bycatch of different species. NOAA also has existing hook and line fisher outreach (e.g., dolphin friendly fishing tips) which can be built upon under this activity.



## **2. Potential partners and stakeholders**

Partnership opportunities could include working with hook and line fishers and associated community groups; researchers including those focused on social science as well as dolphin behavior; other academics; hook and line gear experts; marine extensions; resource managers; and the stranding network. NOAA has multiple potential roles to play throughout all aspects of the project, including being responsible for management of dolphins and hook and line fisheries and expertise across all aspects of this issue.

## **3. Critical knowledge gaps**

Examples of uncertainties related to this potential activity include lack of knowledge about the scope, scale, frequency, and nature of dolphin interactions with the hook and link fishery in Louisiana; inadequate knowledge about bottlenose stocks and abundance and the impacts of hook and line interactions on it; inadequate understanding of dolphin behavior associated with interactions; lack of knowledge about the human dimension and how to incentivize and/or engage with hook and line fishers; and how to evaluate success given lack of baseline data.

## **4. Co-produced solutions**

Co-production of solutions could be based on outcomes of social science studies followed by convening dolphin experts, academics, and fishers together in field research to identify potential solutions. For example, identifying potential mechanisms to safely deter dolphins from interacting with hook and line gear or best practices for fishers to reduce interactions such as limiting intentional or unintentional feeding. This action could also likely benefit from a fishery liaison and marine extension to engage fishing communities.

## **5. Field tests/pilots/evaluation**

Some important aspects of this potential action that could require field testing and evaluation include assessing best practices that emerge from Step 4, including the effectiveness in reducing bycatch or injury and the feasibility and potential for uptake. The field test step could therefore be comprised of testing and evaluating the feasibility and success of potential approaches; working with fishers to incorporate, monitor, and evaluate tested approaches; and monitoring and assessing solution effectiveness.

## **6. Implementation**

Implementation of this action could be based on effectiveness assessed during field tests as well as social science research and outcomes on how to best engage the fishing community and encourage or incentivize use best practices. This could also include implementing outreach actions to inform fishers, such as social media-based campaigns, dock visits, community events, or other engagement mechanisms, as well as incorporating fishery liaisons.

## **7. Evaluation and adaptive management**

This step could include collaborations among fishers, academics, social scientists, resource managers, the stranding network, and others to monitor, evaluate, and adapt solutions. For example, success metrics could include things such as the number of stranded dolphins each year with evidence of recent injury from hook and link interaction. If this number



does not decrease year-over-year, hook and line fishers could be re-engaged to determine if this outcome is a result of lack of awareness or improvements needed to refine best practice to encourage uptake and/or effectiveness, which is then used to adjust the guidance or outreach accordingly. Other metrics could include social science tools to evaluate uptake of solutions by fishers as well as any changes in their behavior or knowledge, and research that focuses on dolphins such as changes in dolphin behavior if applicable.

## **8. Pathway to benefit**

The pathways to benefit for this potential action are to (1) decrease serious injury and mortality of dolphins in hook and line gear by altering fishing practice; and (2) prevent expansion of fishing practices such as feeding that might lead to increased interactions.

### **A.5 Decrease Feeding Associated with Fish Cleaning Stations**

#### **1. Scope and scale of problem**

Researchers and managers hypothesize that intentional or unintentional feeding of bottlenose dolphins at fish cleaning stations may promote depredation or scavenging behavior by dolphins because they associate fishers with food (NMFS, 1994; Powell & Wells, 2011). National Marine Mammal Foundation (NMMF) researchers noticed that dolphins may be learning this association specifically at Grand Isle, Louisiana fish cleaning stations, where some dolphins regularly feed on fishers' discards. This learned behavior may promote subsequent human interactions such as dolphin begging, depredation, and increased risk of injury or mortality from fishery interactions and vessel strikes. This potential action would reduce the risk of dolphin injury and mortality due to learned behavior of associating fishers with food. There is no known ongoing work related to this alternative. However, the NMMF has historical data on Barataria Bay dolphins, fisher interactions, and known individual dolphins who regularly feed on fisher discards at cleaning stations. In addition, the DWH Regionwide restoration project addressing dolphin hook and line interactions may have some overlap with fishers in Louisiana.

#### **2. Potential partners and stakeholders**

Partnership opportunities could include fishers who use cleaning stations; researchers such as NMMF or members of the academic community; marine extensions; NGOs; private fish cleaning services; marinas; and resource managers. NOAA has multiple roles to play throughout all aspects of the project including being responsible for management of dolphins and hook and line fisheries, as well as expertise in many aspects of this issue.

#### **3. Critical knowledge gaps**

Uncertainties related to this potential action include the frequency, nature, and type of interactions between fishers and dolphins at cleaning stations; how widespread the issue is amongst dolphin individuals; whether dolphins are known to engage in risky behavior such as depredation and if feeding at cleaning stations increases those behaviors; and if dolphins are targets of retaliation away from fish cleaning stations. It is also unknown how many fishers who utilize cleaning stations are willing to engage in the effort and the degree to which solutions would be scalable for the recreational fishing community, which is comprised of thousands of anglers.



#### **4. Co-produced solutions**

Co-production of solutions could be based on outcomes of social science and dolphin behavioral studies followed by convening dolphin experts, academics, fishery liaisons, and representatives of the recreational fishing community to identify potential solutions. For example, solutions may include best practice to avoid unintentional feeding as well as methods of outreach to raise awareness and discourage intentional feeding.

#### **5. Field tests/pilots/evaluation**

Some important aspects of this step could include field testing and evaluation to assess best practices identified in Step 4, such as their effectiveness in reducing intentional or unintentional feeding of dolphins at fish cleaning stations. The field step could therefore be comprised of testing and evaluating the feasibility and success of potential approaches at select locations, and monitoring and assessing solution effectiveness.

#### **6. Implementation**

Implementation of activities could be based on the effectiveness and outcomes of pilot tests and social science research on how to effectively scale solutions for Louisiana. Implementation could include various types of on- or off-site informational campaigns to inform fishers of best practice and the importance of not feeding dolphins at fish cleaning stations.

#### **7. Evaluation and adaptive management**

This step could include collaborations among fishers, academics, social scientists, and others, to monitor, evaluate, and adapt solutions. For example, metrics of success could include observed intentional or unintentional feeding of dolphins at fish cleaning stations. If this number does not decrease, social scientists and/or fishers could be re-engaged to determine if this outcome is a result of improvements needed to refine best practice to avoid unintentional feeding or to increase the effectiveness of information campaigns, which is then used to adjust the guidance or outreach accordingly. Other metrics could be focused on observing the number and frequency of dolphins and their behavior at fish cleaning stations.

#### **8. Pathway to benefit**

The pathway to benefit for this potential action is a likely reduction in risk of dolphin injury and mortality associated with recreational fishing activity due to learned behavior of associating fishers with food.



## **A.6 Decrease Incidence of Intentional Harm to Dolphins Associated with Commercial and Recreational Fishing**

### ***1. Scope and scale of problem***

Retaliation by fishers resulting in mortality and sublethal effects has been well documented in Louisiana. Based on strandings data from 2003–2024, 32% of stranded dolphins with evidence of intentional harm were found in Louisiana. NMMF conducted an informal analysis of Barataria Bay health assessment data and found 13% of animals had healed wounds consistent with retaliation (NOAA, 2025). There is no local, ongoing work in Louisiana that directly addresses intentional harm. However, there are other geographic areas (e.g., California, the Mediterranean) that struggle with intentional harm to MMs who depredate or scavenge during fishing activities (Bearzi et al., 2011; Barcenas-De La Cruz et al., 2018; Marine Mammal Commission, n.d.). In addition, NOAA summarized nationwide work on non-lethal deterrents for all species of MMs which are summarized in a technical memo (Long et al., 2015) and issued a proposed rule on guidelines for non-lethal deterrents in 2020 that to date has not been finalized. NOAA’s Marine Fisheries Advisory Committee also conducted a survey in 2024 to gather knowledge and perceptions about the nature of MM interactions and use of deterrents currently employed by commercial, recreational, and tribal fishers; aquaculture farmers; and marina and coastal property owners and managers. However, the results were not finalized and are not currently available. An ongoing hook and line project funded through the NRDA Regionwide TIG is likely to be synergistic this effort and may gather high level, coarse data on fishers and potential frustration. Note, this action is synergistic with another potential action focused specifically on hook and link interaction (refer to A.4) but is more generally focused on intentional harm regardless of the underlying driver.

### ***2. Potential partners and stakeholders***

Potential partners could include hook and line fishers or other representatives of the fishing community; gear experts; dolphin behavior experts; social science and fishery researchers including academics; marine extensions; resource managers; and the stranding network. NOAA has multiple potential roles to play throughout all aspects of the project, including being responsible for management of dolphins and hook and line fisheries and expertise across all aspects of this issue.

### ***3. Critical knowledge gaps***

There are many uncertainties associated with this potential action including lack of understanding about what sectors of fishers are likely to engage in intentional harm; the scope and nature of interactions that lead to frustration, such as scavenging, culling, feeding, depredation; what fishers are specifically experiencing that leads to frustration and intentional harm, such as perceived or real economic loss, damage to gear, competition for fish, and the like; the effectiveness of non-harmful deterrents that could reduce negative fisher-dolphin interactions; dolphin behavior and cognition, and how that impacts interactions; how intentional or unintentional feeding of dolphins may contribute to depredation or predation by dolphins; and lack of information the impact of intentional harm to dolphin stocks including abundance and distribution. There is also uncertainty in what methods can be used to evaluate success given that intentional harm is rarely observed and evidence of intentional harm in recovered dolphins can be difficult to detect without expensive or invasive procedures that may not be used in all cases by the stranding network (e.g., bullets in dead dolphins may sometimes only be detected by conducting computed tomography [CT] scans).



#### **4. Co-produced solutions**

Co-production of solutions could be based on outcomes of social science and dolphin behavioral studies followed by eliciting input from fishers, academics and other researchers, dolphin behavior experts, resource managers, fishery liaisons, stranding network practitioners, marine extension agents, and others to co-produce a suite of potential solutions. These solutions could include awareness campaigns or, depending on the outcomes of the initial studies, development of best practices or gear modifications to limit negative human-dolphin interactions contributing to intentional harm.

#### **5. Field tests/pilots/evaluation**

Some important aspects of this potential action likely requiring field testing and evaluation include assessing potential solutions that emerge from Step 4, including the effectiveness in of non-lethal deterrents to limit negative interactions between fishers and dolphins. This could include joint research that engages fishery experts, dolphin experts, academics, and others to assess the effectiveness.

#### **6. Implementation**

Implementation of activities could be based on the effectiveness and outcomes of pilot tests and social science research on how to effectively scale solutions for Louisiana. For example, information could be elicited from fishers, communication experts, and marine extension agents could be used to scale an outreach or training campaign that encourages human behavior change if field testing supports that solution as effective in reducing intentional harm.

#### **7. Evaluation and adaptive management**

This step could include working with fishers; social science and dolphin researchers including academics; and others to evaluate the effectiveness and uptake of identified solutions. Metrics of success are difficult to identify for this potential action given that one of the key uncertainties is how to effectively quantify the magnitude and drivers of intentional harm. However, social science data collection such as anonymous surveys could be explored. Strandings data could also provide insightful data for evaluation and adaptive management.

#### **8. Pathway to benefit**

The pathway to benefit for this potential action is to likely reduce the risk of dolphin injury and mortality to bottlenose dolphins from intentional harm by increasing public awareness and/or sympathy towards dolphins and/or by decreasing negative human-dolphin interactions.

### **A.7 Enhance Response and Data Collection from Live and Dead Stranded Marine Mammals**

#### **1. Scope and scale of problem**

NOAA Fisheries Marine Mammal Health and Stranding Response program oversees and authorizes stranding response nationwide with partner organizations to respond to and in some cases, rehabilitate stranded animals. In Louisiana, Audubon Aquarium Rescue (AAR) is the only NOAA-authorized organization to respond to and rehabilitate MMs. AAR works with a network of trained volunteers and partners to help respond to MM strandings throughout the state. Most strandings involve dead animals and responders conduct necropsies and collect data to understand disease, illness,



and human threats such as entanglement, vessel strikes, or other issues. The LAMMSN also responds to live animals that are entrapped or in need of rehabilitation. This action would save animals that otherwise might have died without an enhanced level of response or intervention, in addition to collecting data that informs restoration, monitoring and evaluation of success of this and other actions.

## **2. Potential partners and stakeholders**

Potential partners for this potential action could include resource managers, researchers including the academic community, marine extension agents, other local and state agencies and parishes. NOAA has a key leadership role in all aspects of this potential action and specifically authorizes MM stranding response under the MMPA.

## **3. Critical knowledge gaps**

Uncertainties with this potential action include how to adapt, expand, or enhance ongoing efforts along Louisiana's complex and often remote coastline, where MM strandings are difficult to detect or respond to. It is also unknown where and how to target expansion or how effective expanded engagement might be. Stranding rates are also unknown in remote areas and where strandings are difficult to detect, such as in marsh or otherwise vegetated areas.

## **4. Co-produced solutions**

The key partners necessary to co-produce solutions under this action could include authorized stranding responders, NGOs, researchers including academics, dolphin experts, and resource managers. Co-production could include conducting gaps and needs analysis that explores topics such as current capacity, skills, training, equipment, and diagnostics compared to the levels needed to achieve a desired future geographic coverage or capacity, as well as prioritizing needed tools, technologies, or expanded partnerships.

## **5. Field tests/pilots/evaluation**

Although a stranding network already exists in Louisiana, there may be options for exploring additional ways of piloting outreach and engagement activities.

## **6. Implementation**

Implementation of this action could include collaborating with key partners and stakeholders, including the existing stranding network, to implement priorities identified in the gaps and needs analysis. Implementation could include enhancing stranding response, data collection, data entry, and/or reporting, as well as recruiting and training volunteers with a specific focus on targeting needs highlighted in the assessment.

## **7. Evaluation and adaptive management**

This step could include working to synthesize annual stranding data to assess the outcomes of improvements made in response to the gaps and needs analysis, as well as to inform restoration and management of other actions taken under the MM Strategy or by other entities (e.g., the Louisiana TIG). Potential metrics of success are difficult to identify ahead of the gaps and needs assessment along with the unpredictable and variable natures of strandings events themselves. Some examples could include measuring changes in capacity, or other metrics identified through the analysis.



## 8. Pathway to benefit

The primary pathway to benefit for this potential action is saving MMs that otherwise may have died from entanglements, chemical or oil spills, tidal strandings, or other causes without an enhanced level of response or intervention. A secondary pathway to benefit is improved data that informs restoration, monitoring, and evaluation of success for other actions taken under the Strategy or otherwise.



*Bottlenose dolphin and calf (NOAA MMPA Permit No 779-1633). Photo credit: Laura Engleby/NOAA*



## A.8 Develop Strategies that Mitigate Disease and Environment-Related Threats

### 1. *Scope and scale of problem*

Bottlenose dolphins in Louisiana are still recovering from the DWH oil spill and are exposed to many human-caused threats (LA TIG, 2025a). In addition, they are exposed to a range of diseases triggered by or exacerbated by environmental stressors. Understanding disease and environmental related threats is important for restoration because it helps inform the cumulative effects of stressors on these animals and the health of dolphin populations. Understanding dolphin health and determining what impacts them can serve as indicators of ocean health and potential implications for human health, given they share the same habitat and eat the same fish. This action would reduce disease-related mortality or morbidity of dolphins and thereby serve to enhance their resilience and survivability. In rare cases, individual animals may be saved that otherwise might have died without intervention, for example, through freshwater exposure. There are several datasets and reports related to this action that include, but are not limited to, the NMMF in partnership with NOAA and others' historical data sets related to health of dolphins in Barataria Bay, LA (Smith et al., 2022); Mississippi State University's investigation into diseases in MS dolphins, some of which overlap in Louisiana; two comprehensive draft reports: "Evaluating the threats of disease, contaminants, and environmental hazards on Louisiana dolphin health: A literature review, conceptual model, and health assessment plan" (LA TIG, 2025b), and the "Freshwater Response, Scientific/Impact Assessment, and Decision-making Strategy Report" (LA TIG, 2025c); Health MAP, a centralized, web-based data system designed to integrate MM health data with oceanographic conditions and other information to help detect emerging threats and prioritize conservation efforts (NOAA Fisheries, 2025b); and the NOAA led MM and unusual mortality event program (NOAA Fisheries, 2026).

### 2. *Potential partners and stakeholders*

Potential partners for this potential action could include NOAA managers; MM veterinarians, pathologists, epidemiologists, and other experts in MM health; researchers including those from the academic community; non-profits; resource managers; the Marine Mammal Commission; and the stranding network. NOAA has a key leadership role in all aspects of this potential action, including through the coordination across the efforts described above and in implementation, provision of expertise, and oversight.

### 3. *Critical knowledge gaps*

Uncertainties related to this potential action include lack of information regarding types of diseases and disease trends; how disease contributes to or exacerbates other stressors—including those related to human activities—as part of understanding cumulative effects; sources of pollutants; environmental drivers of disease in Louisiana; how to manage the release of rehabilitated animals that were exposed to disease such as Brucella; what technologies for treating or addressing disease or its drivers are ready and feasible for implementation and/or factors limiting development; how to effectively mitigate or treat disease in dolphins and dolphin populations; how to ensure long-term sustainability for diagnostics and sample archiving; and inadequate knowledge about dolphin distribution, stock structure, and populations as it relates to disease and disease impacts.



#### **4. Co-produced solutions**

The key partners necessary to co-produce solutions under this action could include experts in MM disease in and beyond Louisiana, as well as researchers (academic, NGO) and the stranding network. Activities could include working with those groups to characterize what is known and currently being measured regarding MM disease in Louisiana, including potential emerging threats, and/or convening an expert working group to identify high priority gaps and needs—including investigations, data integration, and analysis—to develop a mitigation and framework plan specific to Louisiana.

#### **5. Field tests/pilots/evaluation**

The need for and potential benefit of field testing and evaluation for this potential activity could be evaluated depending on the outcomes of the needs assessment conducted in Step 4. There are multiple potential opportunities that could be tested such as direct intervention to respond to disease when feasible; exploring and advancing new technologies such as the remote dart delivery of antibiotics; identifying and providing voluntary “best management practices” that could reduce environmental stressors, such as reducing agriculture run off or freshwater inputs; and increasing awareness about MM health among the public, coastal communities and decision-makers.

#### **6. Implementation**

Monitoring and evaluation of activities conducted in field testing could be used to scale those activities that are the most feasible and/or effective in improving disease outcomes. In addition, depending on the Step 4 co-produced needs assessment, implementation of this action could include health assessments; strengthening capacity for disease detection; surveillance of stocks and populations; investigation and response to existing or emergent diseases; ensuring sustained capacity for long-term sample archiving (e.g., through the National Institute of Standards and Technology); mitigating disease risk factors when feasible and known; and identifying paths forward to advance technologies and methods such as conservation medicine.

#### **7. Evaluation and adaptive management**

This step could include synthesizing data on an annual basis to regarding disease outcomes, specifically as it relates to any activities field tested or implemented at scale. This data and its analysis could also be used to inform restoration and management of other actions taken under the Strategy or by other entities (e.g., the Louisiana TIG) as part of reducing the cumulative effects of disease and other stressors on MM populations.

#### **8. Pathway to benefit**

The pathway to benefit for this potential action is to likely reduce disease and environment-related threats causing impacts, mortality, and morbidity of bottlenose dolphins, thereby improving their health and resilience.



## **APPENDIX B. Lessons Learned in Establishing Communities of Care for Marine Mammals**

### **B.1 Introduction**

In order to learn from organizations that have experience with building durable and credible MM programs and community presence, the Institute team conducted informal interviews with leaders from three organizations repeatedly identified by potential partner groups as exemplars in the MM field. These entities included two NGOs and a university program, each with a minimum of 20 years and one with 55 plus years' experience of leading a long-term MM program. The goal was an exploration of lessons learned. Interviews were open-ended and included prompts such as identifying what essential elements of a successful long-term program are; what barriers or challenges their programs encountered; what partnerships have been most important; and what their models were for engagement. The Institute team synthesized common themes from input received during these conversations to identify key elements, described below, that—based on the input received from the interviewed experts—are likely to represent important factors to consider for a Louisiana MM programmatic approach given their identified relevance to other, successful long-term programs.

### **B.2 Relationships as a Foundation for Success**

All interviewees described relationships as the single most important element of a successful long-term community of care for dolphins, with program success tightly correlated to the quality and nature of relationships. In this context, relationships refer to those between organizations and groups as well as connections between individuals, all of which were cultivated over time through a consistent presence, following through on commitments, and taking time to understand what different groups care about and why. All three were clear that this kind of relationship-building requires a focused investment of time and resources as well as skillful interpersonal communication and credibility.

Interviewees noted that relationship-building is most effective when it includes going where people are; engaging among diverse sectors such as fishing communities, businesses, schools, and government agencies; and considering where dolphin restoration might overlap with existing community concerns. Interviewees also noted that engagement should be customized to the group to be effective in understanding what each group finds important, noting that different groups engage more effectively through town halls, lectures, on-the-water experiences, K-12 education, or other means. Identified examples of factors in ineffective relationship-building included researchers or organizations coming in with a pre-determined approach; making assumptions about what the communities need; or engaging only episodically. Factors that contributed to success included consistency, transparency, co-production, and committed embeddedness in the communities where the work happens. Establishing a year-round presence is therefore essential because, as one interviewee noted, the dolphins are there year-round, and the program and its people should be as well. Furthermore, established relationships are invaluable in supporting response to a crisis such as an oil spill or other mass mortality events.



## B.3 Credibility

Interviewees also noted several factors important to building relationships, with credibility identified as a fundamental component. Credibility was emphasized across all three interviews as needing to be built gradually through honesty, consistency, information sharing, and follow through over time. Being known as an honest broker that provided information and expertise without advocacy, and that doesn't come into communities telling people what they should or shouldn't do, was consistently described as essential to being trusted and welcomed in a community. Program success relied on engaging communities in co-producing the work, sharing data and results openly, incorporating local knowledge and expertise, and treating community members as true and sustained partners in problem solving.

Conversely, interviewees identified approaches that extracted local data and information over a short period without further community engagement as less effective. Co-production of solutions was repeatedly identified as beneficial to building trust and in addition to being a practical approach to solving complex problems, particularly fishery-related ones. Interviewees noted that, in general, the more programs work together with communities, the more effective they are at working together, and the more momentum they build in attracting additional collaborators to the table. Having researchers who are from or deeply embedded within communities where they work was also described as essential and generated a type of credibility that outside experts who come and go cannot easily replicate. Interviewees described working with local subject matter experts as another effective way to identify additional key partners and build credibility within communities. Overall, interviewees described credibility as a natural outcome of doing the work well, transparently, and with respect for the people and communities that are involved.

## B.4 Continuity, Consistency, and Commitment

All interviewees described continuity, consistency, and long-term commitment as essential to cultivating and sustaining relationships over time and therefore as important components to long-term success. All three interviewees were emphatic that successful long-term efforts for long-lived animals cannot easily be built on short-term funding projects, episodic engagement, or with a high turnover in personnel. One of the major challenges they identified is how the timescales these animals need for restoration exceed most funding timescales. As one interviewee noted, dolphins born today will outlive a biologist's career and therefore understanding population-level recovery from a major event like DWH will take decades to detect; by extension, monitoring and people need to be there for decades, as well. Thus, ensuring support for year-round staff to do the baseline work without depending on piece meal funding or grants is essential.

Interviewees also noted that a successful program depends on consistent work that builds longitudinal data needed to detect change and a stable base of operations that establishes a lasting presence to the partners and communities. Program efforts that came and went, or those that relied on rotating students or staff without continuity of leadership, were cited as cautionary examples. They noted that programs that endured and are considered models of success did so because they made a long-term commitment, built a community of practice, and found support for core work to effectively survive the chronic funding uncertainty associated with this field. Interviewees noted that consistency is also directly linked to credibility, with both enhancing a program's ability to attract additional partnerships and leverage opportunities over time. Thus, the more established and durable the program is, the more likely it will be to attract additional external support from a variety of sources, and therefore to become sustainable over time.



## B.5 Community

Interviewees noted that building a long-term sustainable community of care requires understanding what the local community values and where dolphin restoration efforts can meaningfully connect to those existing priorities. They also emphasized the importance of finding common ground as a starting point for bringing different perspectives together, such as a shared appreciation for the health of the bays, concern about livelihoods, or addressing negative interactions of dolphins and fishing gear. They also noted that understanding and integrating with the local culture is a valuable and often underutilized opportunity for connections, such as by engaging through food, music, art, or other events that bring communities together.

Interviews also noted that local champions within specific communities—such as a multi-generational fishing family, economic development leader, or other community organization—can make connections that would be otherwise difficult to make. One interviewee shared that when fishers learned more about dolphins, they became more open to trying new approaches to fishing and caring about the animals. Another interviewee provided a vision for Louisiana where the community engagement expands to become a community of knowledge, where local people are not just participants but understand the broader context of dolphin restoration, feel able to contribute, and remain connected to the effort over time.

## B.6 University and Academic Partnerships

The interviewees noted that universities and academic institutions can contribute significantly to dolphin restoration by enhancing the capacity, reach, and durability of a long-term community of care and associated research in ways that are difficult to achieve otherwise. The identified benefits of academic involvement included a steady supply of students who can support data collection and contribute to monitoring at a relatively low cost; access to specialized expertise across multiple disciplines such as fisheries management, marine extension, social science, and veterinary medicine; and an institutional infrastructure that can provide some buffer from funding uncertainties that smaller, independent organizations routinely face.

Interviewees also noted academic involvement is likely to attract additional and complementary funding and resources over time as students, labs, and programs are drawn to the complex challenges and compelling scientific questions about dolphins in the wake of DWH. Interviewees highlighted an endowed university position as a potential way to ensure continuity of scientific leadership and presence over time. All interviewees agreed that the value of academic partnerships depends on how they are structured and whether they are built on a foundation of consistency, co-production, credibility, and long-term commitment. It was specifically noted that students may come and go, but the academic program and its relationships need to be set up to last.



## **B.7 NOAA as a Consistent Partner**

The importance of NOAA as a long-term partner whose engagement is valuable through all phases of restoration, and not just as a funding or permitting entity, was raised by all three interviewees. They noted that this relationship works best when it is built on mutual trust and maintained over time, rather than activated only when there is an immediate need. One interviewee described the value of early and sustained involvement in their relationship with NOAA, with that engagement including participating in working groups and panels, and in general serving as a reliable and credible source of information on agency priorities and needs. Interviewees also noted that working with government agencies more broadly, rather than solely viewing them as a regulatory entity, is an opportunity to find common ground, open doors to opportunities, and address the needs of constituents. The consistent message across all three conversations was that NOAA is an essential partner in any long-term effort, and that investing in that relationship deliberately and often is valuable.

## **B.8 Funding and Staffing/Resources**

Interviewees noted that sustained, stable resources are a critical element of any long-term program. They described attempting to piece together a long-term program through short-term funding mechanisms, part time staff, or rotating personnel as ineffective. They also described investment in people or staff as essential to effectively conducting restoration work, because establishing people with the right capacity builds relationships, maintains long-term data, and conveys to partners and communities that the effort is reliable, committed, and sustained. They also linked credibility to consistency, which requires people with funding to be there reliably and not leave after a short time. The funding models for long-term programs identified as working the best are those that provide a stable base of institutional funds, whether through a zoo's conservation mission, an endowed university position, or a dedicated non-profit. Interviewees also noted a leveraging argument for investment in stable human capital, given that having the right personnel over time attracts additional funding, partnerships, and complementary resources that extend the reach and impact of the initial investment in the base program.

## **B.9 Implications for the Louisiana Strategy**

Taken together, the common threads across the three interviews provide a consistent understanding of the key elements for building a long-term, sustainable community of care for bottlenose dolphins in LA. All three interviewees noted that while there was a significant impact on dolphins from the DWH oil spill, there is also an opportunity. Interviewees noted that the long-term consequences of DWH remain unknown and important questions remain about restoration and the effectiveness of restoration. They noted that the LA restoration funds provide a rare opportunity to intentionally build a sustainable program in the state from the ground up.

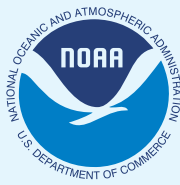
At the same time, all three were candid about existing gaps such as a lack of established relationships between MM experts with fishing and other communities; insufficient year-round presence of dolphin monitoring effort; and a need to establish partnerships. One interviewee emphasized the difference between a long-term community of care and a long-term research program, where the former is focused on human capital, relationships and community, and the latter on data collection and science, and noted that it's important to deliberately combine both together. These three perspectives, each representing programs with decades of experience building and sustaining dolphin community-of-care programs regionally, nationally, and internationally, offered insights into what has worked, where efforts have fallen short, and what efforts in Louisiana could consider in order to be successful in the restoration of these dolphins.



*Pantropical spotted dolphins in northern Gulf of America (Permit No 21938-03). Photo credit: Mary Applegate/NOAA Fisheries*



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