



ALLEGHENY COLLEGE

*Literary Exploration of the Barataria Bay Disaster: Saving Bottlenose Dolphins in the Face of
Catastrophe*

By

Samantha Dzierba

Department of Environmental Science and Sustainability

Allegheny College

Meadville, Pennsylvania

March, 2025

***Literary Exploration of the Barataria Bay Disaster: Saving Bottlenose Dolphins in the Face of
Catastrophe***

Samantha Dzierba

**A senior comprehensive project in partial fulfillment of the requirements for a Bachelor of
Science degree from Allegheny College.**

*I hereby recognize and pledge to fulfill my responsibilities, as defined in the Honor Code, and to
maintain the integrity of both myself and the college community as a whole*

Senior Thesis Committee:

Dr. Casey Bradshaw-Wilson

Dr. Terrence Bensel

Table of Contents

Tables and Figures.....	iv
Acknowledgements.....	vii
Abstract.....	viii
Introduction.....	1
Methods.....	5
Conservation Management Plan.....	7
References.....	17

Tables and Figures

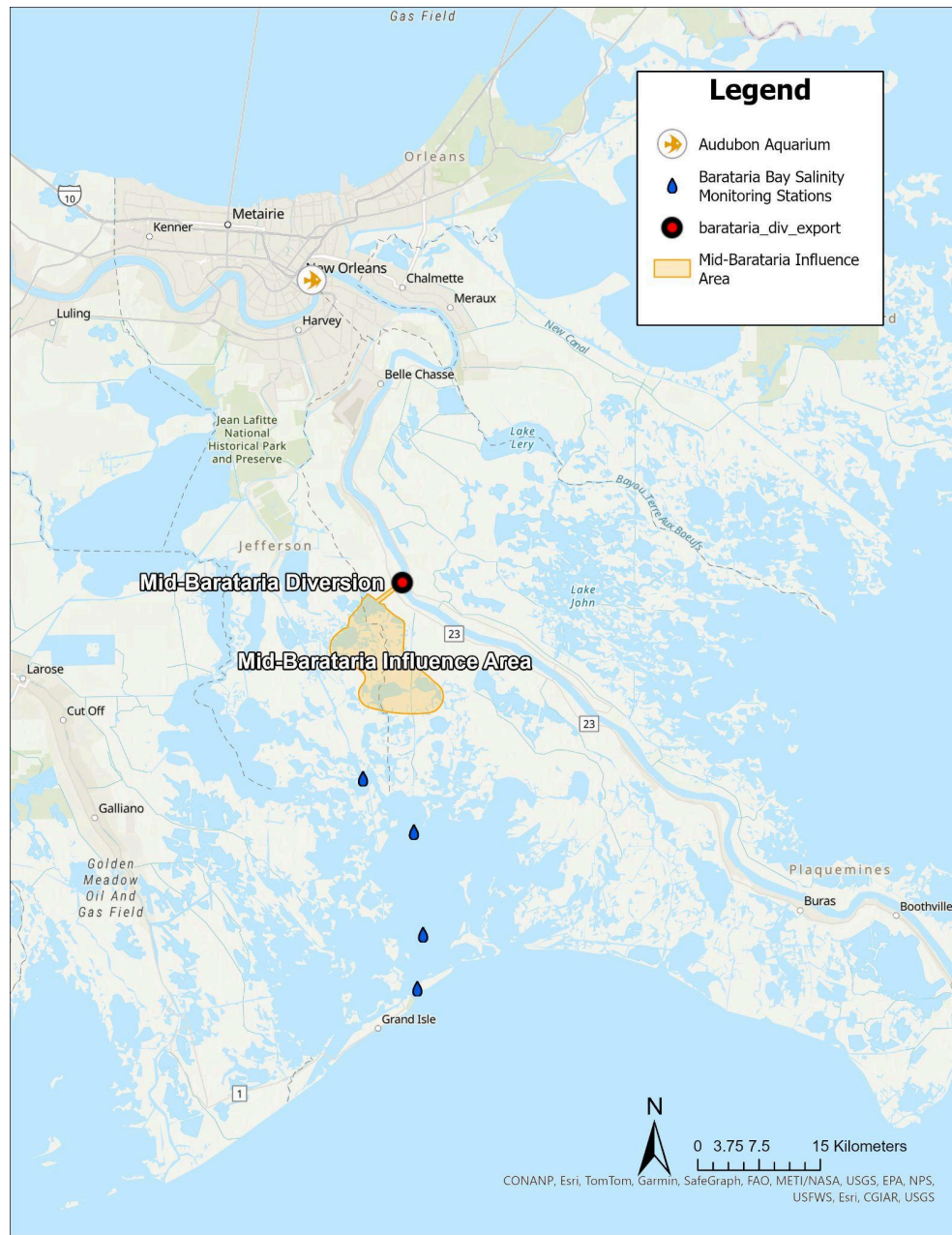


Figure 1.0: ArcGIS Pro map depicting key locations within Barataria Bay, LA. Locations include Audubon Aquarium, Mid-Barataria Sediment Deposition site, Mid-Barataria Sediment Diversion project affected area, and salinity monitoring stations.

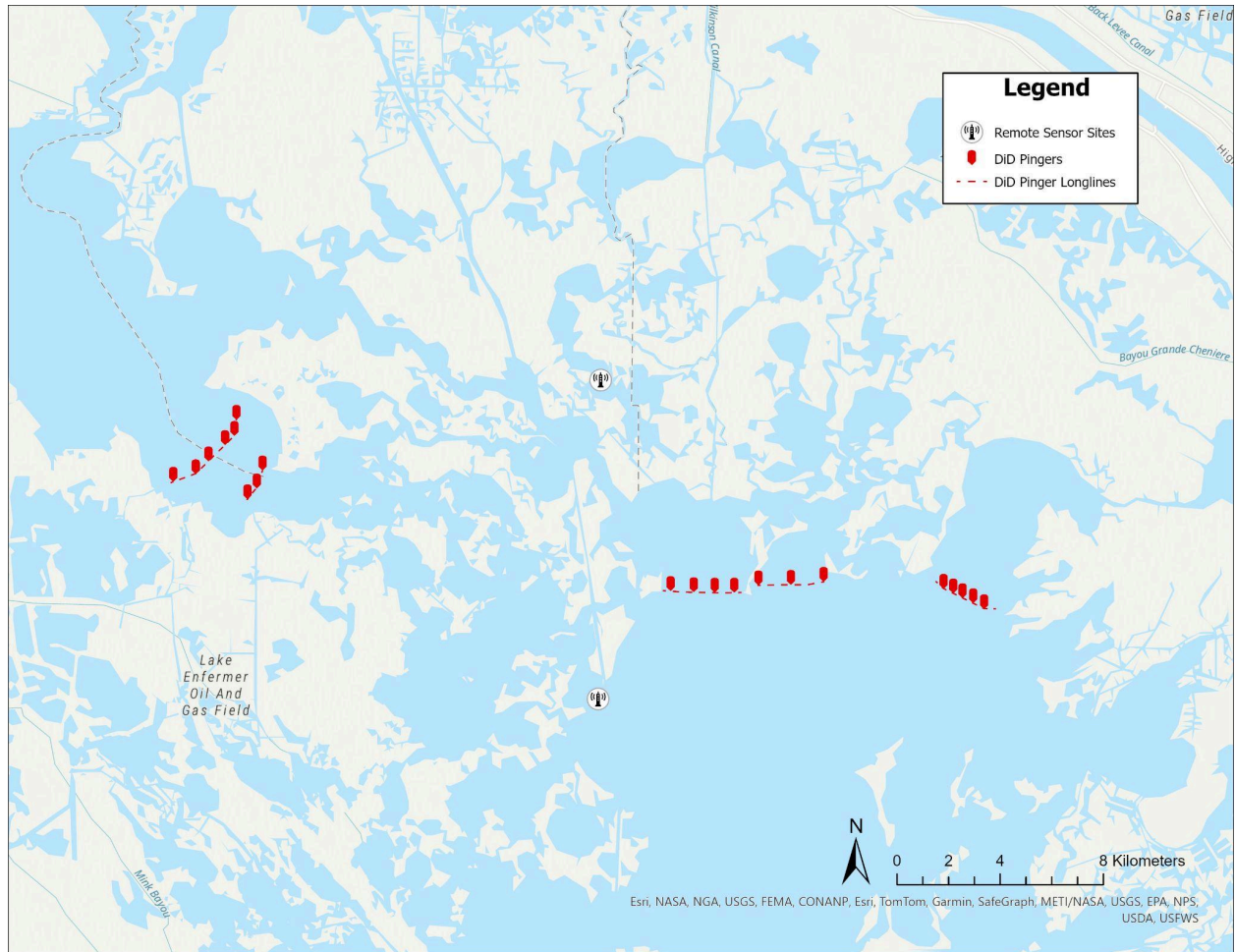


Figure 2.0: ArcGIS Pro map depicting locations of potential deterrence measures. Measures include acoustic pingers with their respective longlines and remote movement sensors.

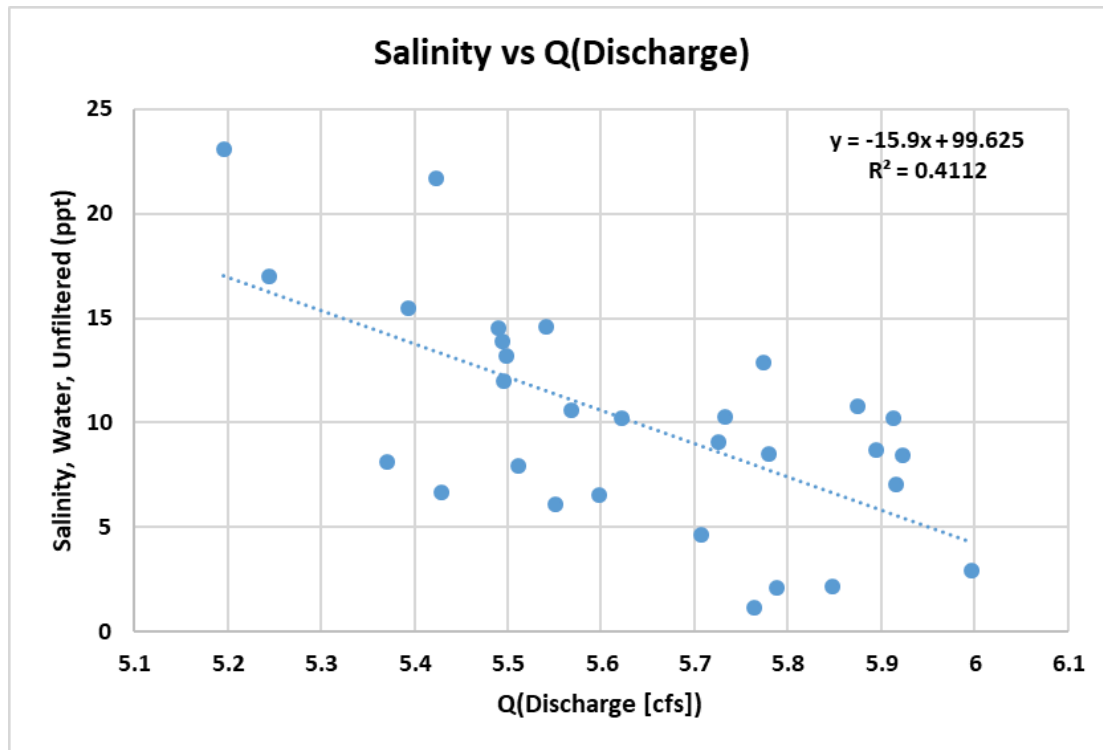


Figure 3.0: Salinity (ppt) vs Q(cfs) within Barataria Bay. Salinity measurements (ppt) were taken from Barataria Waterway at Mud Lake S of Lafitte, LA (USGS n.d.a.). Discharge (cfs) measurements were taken from the Mississippi River Delta at Belle Chasse, LA (USGS n.d.b).

Acknowledgements

Thank you, Dr. Casey Bradshaw-Wilson for being an attentive and encouraging academic advisor and senior thesis advisor who never doubted my ability.

Thank you to my parents, Thomas Dzierba and Kathryn Welton, who have believed in me and my education since my first day in a classroom.

Thank you to my grandmother and grandfather, Raymond and Victoria Dzierba, who I know are watching me graduate in their own way.

Thank you to Dr. Lisa Whitenack for encouraging me to pursue my passion no matter how many times I doubted myself.

Name: Samantha Dzierba

Date: Spring, 2025

Major: Environmental Science

Thesis Committee: Dr. Casey Bradshaw-Wilson, Dr. Terrence Bense

Title: *Literary Exploration of the Barataria Bay Disaster: Saving Bottlenose Dolphins in the Face of Catastrophe*

Abstract

Bottlenose dolphins (*Tursiops truncatus*) are one of the most well-known keystone species of the sea. This recognizable dolphin species supports their ecosystem through predation, habitat stimulation, and nutrient cycling (Born Free). *Tursiops truncatus* are found across the globe in both temperate and tropical waters, including Barataria Bay, Louisiana. This bay resides in the Northern center of the Gulf of Mexico, and one of the largest *T. truncatus* pods in the Gulf of Mexico resides here. This pod lost almost half of their 4,000-individual population size due to the Deepwater Horizon oil spill in 2010, and it now faces another ecological hazard: the Mid-Barataria Sediment Diversion Project (MBSD). The MBSD aims to restore eroded marshland by depositing large amounts of sediment and freshwater into Barataria Bay. This construction would bring back species that once depended on this marshland but will be detrimental to the *T. truncatus* pod. *Tursiops truncatus* are known for their high site fidelity, even with lowering salinities, a decision that will lead to their extirpation. The MBSD contains a Dolphin Intervention Plan, but it focuses only on remote observations and what to do when a deceased *T. truncatus* individual is found. The goal of this research was to create a more appropriate and in-depth conservation management plan for the Barataria Bay *T. truncatus* pod. After a large-scale literature analysis, a new dolphin intervention plan was created using a 4-tier approach. Each tier represents a worsening ecological situation, and as they progress to 4, Barataria Bay and the *T. truncatus* pod within it fall further and further away from the possibility of successful rehabilitation, emphasizing human intervention as a tool to help as many *T. truncatus* individuals as possible. Efforts such as technological development, rehabilitation, observation, deterrence, and cooperation with the MBSD project itself were all included in this plan.

Introduction

On the southern border of Louisiana lies Barataria Bay, a saltwater bay with many branching streams and inlets. It lies in the Northern center of the Gulf of Mexico, and is a shallow estuarine system, with an average depth of 2 m (National Marine 2022). This bay is also a popular fishing spot and is 100 km long and 50 km wide, making it an important habitat for a variety of marine species (Barataria 2023). One such species living in these waters is the common bottlenose dolphin (*Tursiops truncatus*). A population resides in the Bay of 2,000 individual dolphins, which are part of one of the largest *T. truncatus* populations in the entire Gulf of Mexico (Barataria 2023). Despite this being a substantial population, it is believed that this *T. truncatus* pod has both long-term and year-round residency in the waters of Barataria Bay (Wells et al. 2017). *Tursiops truncatus* is known for having a higher sense of site fidelity than other dolphin species, but this specific population seems to have even higher site fidelity receptors (Takeshita 2021). These individuals have been observed staying in their home range, even with salinity contents of less than 5 ppt, 30 ppt less than normal (Takeshita 2021). Although this site fidelity may be a useful tool to study this *T. truncatus* population, it may ultimately lead to their demise.

In 2010, the bay was decimated by an oil spill due to Deepwater Horizon Oil (Barataria 2023). The pod has spent the last 14 years recovering from this incident, as they lost 45% of their population (Barataria 2023). Again, due to high site fidelity, this population refused to leave during said oil spill, leading to a mass fatality event (Takeshita 2021). Many health impediments arose from living in oil, and 17% of individuals evaluated were not expected to survive (Schwacke and Smith et al. 2014). A major health concern of *T. truncatus* during this time was the presence of *Brucella*, a bacterial infection found to be a major cause of death for perinatal *T. truncatus* calves (De Guise et al. 2017). These health concerns continued to affect this pod for the next several years after the Deepwater Horizon Oil spill. In 2011, 46% of perinatal calves either stranded themselves or washed ashore on beaches across Louisiana, double the amount of stranding events that occurred between 2003 and 2010 (Carmichael et al. 2012). Adult *T. truncatus* also suffered from these conditions, as the annual survival rate for this species throughout the entire Gulf of Mexico was at 0.73, a number so low it is consistent with a large-scale unusual mortality event for cetaceans (Mullin et al. 2017). Not only did the survival rate of *T. truncatus* decline, but reproductive success dropped. Nineteen point four percent of

females observed had a successful reproductive rate after living in the oil contaminated water (Kellar et al. 2017). The pod has not completely recovered from this event, as the estimated recovery time was found to be 39 years (Scwacke and Thomas et al. 2017). While still recovering from the past, *T. truncatus* now faces a new imminent threat: the Mid-Barataria Sediment Deposition Project (MBSD).

The Mid-Barataria Sediment Deposition Project is part of a much larger picture, known as “Restore the Mississippi Delta.” It aims to divert freshwater and sediment into Barataria Bay in the name of restoring critical marshland (*Mid-barataria*). The marshland in question has been eroded through consistent use of canal excavations, extreme weather, oil and gas extraction, and, more prevalently now than ever, sea level rise (*Barataria* 2023). The MBSD mission is to both build and support thousands of restored acres of land, allowing for an increased measure of weather protection for nearby counties and creating a protected estuary for a variety of fish and wildlife (*Mid-barataria*). The trail of freshwater and sediment is approximately 3,218.69 m long and 487.68 m wide with a maximum flow rate of 75,000 cfs (*Mid-barataria*). A key piece of the project is that the channel flowing freshwater and sediment into the Bay can open and close (A. Renfro, personal communication, October 24, 2024). This aspect adds to the uniqueness of this restoration project, along with the many benefits created from the expense of marine life already living in the bay. Unfortunately, the MBSD has emphasized the importance of restored marsh land versus impacts to the bay itself, including the large population of *T. truncatus*.

This proposition is also cited as being economically beneficial to surrounding counties struggling to adapt to a loss in coastline, but it will lead to the extirpation of the *T. truncatus* pod living within the bay (*Barataria* 2023). The state of Louisiana has lost over 492,098 ha since the 1930s, and the imminent threat of sea level rise predicts additional loss of more than 1,035,995 ha (A. Renfro, personal communication, October 24, 2024). Additionally, billions of dollars would be brought into surrounding parishes through increased sales, household earnings, and jobs produced (*Mid-barataria*).

Coastal communities have had to make an increasing number of ecological decisions as climate change rapidly affects sea level rise (Kistner 2022). Shrimp and oyster fisheries have moved their operations closer to shore over time, but with changing salinities, they will need to move out much further to avoid freshwater (A. Renfro, personal communication, October 24, 2024). Granted, the restoration of marshland is precedent and will likely increase ecosystem

health in this area, but it will also increase the flood risk for nearby communities (A. Renfro, personal communication, October 24, 2024). Negative aspects like these, along with hesitance to change, has created a controversy leading to lawsuits filed by nearby parishes that would be negatively affected (L. Schwacke, personal communication, October 24, 2024).

Dolphins of any species are protected by the Marine Mammal Protection Act (MMPA). This official act states that it is illegal to “take” marine mammals without a permit, and humans may not harass, feed, hunt, capture, or kill any marine mammal (Congress 2022). Although this act is still in existence today, government officials waived its protections to allow the project to move forward (Takeshita 2021). The Budget Act was enacted on 9 February 2018, requiring the waiver of specific parts of the MMPA to allow construction to move forward (National Oceanographic 2018). Sections 101(a) and 102 of the MMPA were waived by the National Marine Fisheries Service after a consultation with the Marine Mammal Commission (National Oceanographic 2018). The project then broke ground in August 2023, with an estimated 585 dolphins lost in the first year of construction alone (*Dolphin Intervention Plan*). Due to a lawsuit from Plaqueman’s Parish, construction was halted, therefore the estimated effects have not currently been seen in Barataria Bay (L. Schwacke, personal communication, October 24, 2024).

The added freshwater will lead to health concerns for *T. truncatus*, including epithelial erosion, edema, hydropic degeneration and separation of superficial epithelial cells, and skin sloughing (Deming 2020). Some of these conditions can resolve themselves after returning to higher salinities, but some will continue to worsen over time. A large concern is corneal edema, a condition that has been seen to get worse over time, even when living environments return to suitable salinities (Deming 2020). However, the Barataria Bay pod has exhibited such high site fidelity that impending skin lesions will likely never heal, as they refuse to leave the environment causing distress (Takeshita 2021). The severity of these lesions increases as salinity decreases, therefore as time passes for the MBSD construction, the lesions will worsen with degrading salinity (Wilson et al. 1999). Individuals with severe skin lesions are susceptible to fungal, bacterial, and algal infections leaving yellow, green, or orange discoloration on *T. truncatus* skin (Duignan et al. 2020). Previous research has found that *T. truncatus* would have decreased time to live when exposed to low salinities (Booth and Thomas 2021). In fact, these individuals typically only have 22 days to live when their living conditions exist in low salinity environments (Booth and Thomas 2021). As this dolphin population continues to live in a

lowering salinity, health issues are predicted to increase until their extirpation from Barataria Bay.

These health defects will not only affect *T. truncatus* individuals themselves but the entire Bay ecosystem. These animals are considered apex predators in estuary systems like the one in Barataria Bay (University), and through their predation on prey such as squids, small fishes, and crustaceans, they keep population numbers in check and balance the natural food chain (*Bottlenose*). *Tursiops truncatus* is also a key habitat stimulator. This species of dolphin is known for a variety of feeding and hunting habitats that require them to burrow their rostrums into the sand (Born Free). This process kicks up sediment, plant growth, and even small prey organisms, which redistributes resources in an estuary (Born Free). Through this process, estuary habitats are stimulated and changed, promoting plant growth, macroorganism migration, and the start of nutrient cycling. By kicking up plant and animal matter within the sand, it gives other predator species a chance to eat without having to hunt. This adds to the natural nutrient cycle found within estuary ecosystems, as it promotes more consuming and digesting of living and nonliving matter. *Tursiops truncatus* activity is so important to an estuary that the health and abundance of this species can be used as a broad measure of both ecosystem viability and integrity (University). Without the presence of *T. truncatus*, predator and prey populations would be disrupted, and ecosystem health would be damaged beyond repair causing a massive trophic cascade. The effects from the MBSD will completely change the ecosystem within Barataria Bay, and the extirpation of the dolphins themselves will almost certainly make sure it never returns to normal (*Bottlenose*).

The proposed MBSD project includes a Dolphin Intervention Program, but it will have little to no positive effects on this pod. The only true methods of intervention listed in the program report are conducting necropsies on stranded dolphins while simultaneously observing living population numbers as freshwater continues to come into the Bay (*Dolphin Intervention Plan*). The MBSD plan describes limited efforts of how to intervene before effects start to take place. Broken into different sections, the Dolphin Intervention Plan touches on remote behavioral observations, remote sample collections, and remote treatments (*Dolphin Intervention Plan*). All three categories have no further explanation as to what observations, sample collections, or treatments would look like or highlight. In fact, the only concrete information given is that “standardized” remote health assessments will be regularly done (*Dolphin Intervention Plan*).

What this standardized assessment is based on, however, is not explained. A brief section on herding, hazing, and deterrence is included, but readers are referenced to an outside source explaining certain ethical types of marine mammal deterrence methods, with no inclination that they will be used in this project (*Dolphin Intervention Plan*). A *Dolphin Intervention Plan* may be seen as an inappropriate title for a management plan that does not logistically intervene.

The final Environmental Impact Statement found that the *T. truncatus* pod living in these waters will experience a substantial reduction in population numbers and survival rates with an increase in health concerns (U.S. Army Corps of Engineers 2022). This pod is predicted to lose at least 681 individuals in the first two years of construction (Thomas et al. 2022), and the entire population is expected to be extirpated within the first 10 years of construction (Garrison et al. 2020). A smaller and separate plan to rescue and rehabilitate a *T. truncatus* mother and calf was used in Barataria Bay, but it took a team of 30 people to rehabilitate these two dolphins into a new area, not a feasible plan for a pod of over 2,000 (Schleifstein 2023). Overall, the current plan does not explicitly include dolphin intervention, it provides guidance on what to do once this population starts declining.

The objectives of this project are to create a new *Tursiops truncatus* intervention plan that has a larger emphasis on intervention rather than post-mortem body collection. I propose a new plan should be created, focusing on how to best protect this population before death tolls begin to rise while finding a way to compromise with construction goals. In order to ensure the Barataria Bay pod can persist into the future, a comprehensive plan is critical. Construction began on August 10, 2023, and over 500 dolphins were predicted to die within the first year of installment (*Dolphin Intervention Plan*). The *T. truncatus* death toll is nowhere near the predicted death toll due to the Plaquemans' Parish lawsuit; however, these declines will eventually become reality if changes are not made. The current Dolphin Intervention Plan does not appear to grasp the sense of urgency this situation requires.

Methods

I approached my objectives using a literature analysis. The management plan itself is focused on saving as many *T. truncatus* individuals as possible, so multiple aspects of this conservation issue will be considered. Subjects researched include *T. truncatus* habitat requirements, Mid-Barataria Sediment Diversion project details, and intervention efforts related

to *T. truncatus*, including deterrence methods, rescue and rehabilitation costs, and current and projected stranding efforts. Funding and resource allocation is the only facet that has not been considered. This information was found within a variety of databases, including, but not limited to, PubMed, JSTOR, ScienceDirect, and Google Scholar.

Informal interviews were also conducted with a number of individuals involved with the diversion project and/or impacts. Dr. Lori Schwacke, the Director of Scientific Programs for the Marine Mammal Commission, and Ms. Alisha Renfro, the Senior Manager for Science Policy/Gulf Program for the National Wildlife Federation, were interviewed via Zoom call on October 24, 2024. Three other professionals were contacted, including members of the Coastal Protection and Restoration Authority, Marine Mammal Commission, and Louisiana Wildlife and Fisheries but either declined to participate or failed to respond. Those that declined to participate had varying reasons, including lack of knowledge and time to sit down with me, but both individuals offered resources in lieu of being interviewed. The responses that were collected were used to further update the specificities of my conservation management plan, as those working on the MBSD project or trying to mitigate its effects will have more general knowledge of this conservation issue and can provide insight into the plan itself.

The conservation management plan was created using a 4-tier approach. The physical appearance of the conservation management plan mirrors the format of the current Dolphin Intervention Plan (*Dolphin Intervention Plan*). Each tier represents a different level of situational severity that corresponds with an increase in intervention measures. As the tiers progress to 4, intervention increases and accumulates until the final tier. This final tier represents the worst outcome for Barataria Bay, emphasizing human intervention to help as many *T. truncatus* individuals as possible. Each step has a clear and replicable protocol as well as the justification behind its implementation.

Two visual representations of Barataria Bay and selected intervention efforts were created through ArcGIS Pro. Figure 1.0 was created to represent important locations in LA, including the Mid-Barataria Sediment Diversion site, Mid-Barataria Sediment Diversion project affected area, Audubon Aquarium, and four salinity monitoring stations within the bay. Figure 2.0 was created to represent deterrence measures, including acoustic pingers with the longlines they must be attached to and ideal remote sensor locations. Microsoft Excel was also used to create a linear regression model showing the effect of discharge (cfs) on salinity (ppt) within Barataria Bay

(Figure 3.0). The regression model accurately displays this relationship, but confounding factors such as precipitation, distance between salinity and discharge monitoring sites, and wind were not taken into account here, making the final calculations hypothetical.

This conservation management plan was submitted to the Environmental Science and Sustainability program at Allegheny College for final review. It will also be sent to Dr. Lori Schwacke and the Marine Mammal Commission for their consideration and feedback.

Conservation Management Plan

This Dolphin Intervention Plan for the Mid-Barataria Sediment Diversion Project (MBSD) outlines a cohesive four-tier strategy to best mitigate the negative effects from the introduction of freshwater and sediment into Barataria Bay, LA. This conservation management plan details four approaches to the effects of the MBSD based on the rate of decline in *T. truncatus* health and abundance. As the tiers progress from 1 to 4, the *T. truncatus* population declines further. This plan is a comprehensive overview of a variety of methods used to intervene and protect *T. truncatus* from the effects of the sediment diversion project and how they can be applied to the MBSD.

Purpose and Goal

The purpose of this Dolphin Intervention Plan is to educate and instruct the decision-making process for the *Tursiops truncatus* population living in Barataria Bay, LA. The structure of this conservation management plan gives instructions on how to interpret the severity of the Bay's health and how to mitigate the worsening effects of the Mid-Barataria Sediment Diversion project. Four tiers are created to represent worsening situations in Bay, with Tier 1 representing limited stressors and Tier 4 representing maximum stressors. In each case, the main goal is to save as many *T. truncatus* individuals as possible while keeping them in the best health condition possible.

Legislation

The Marine Mammal Protection Act (MMPA) prohibits the “taking” of marine mammals, and forbids the harassment, feeding, hunting, capturing, or killing of any marine mammal, including *T. truncatus* (Congress 2022). The Secretaries of Commerce and Interior are both

responsible for upholding the MMPA to its entirety, as well as processing waiver requests for subsistence harvest, research, and construction projects, such as the MBSD.

Bipartisan Budget Act of 2018 (Budget Act), Public Law 115-123 required the Secretary of Commerce to issue a waiver of MMPA moratorium and prohibitions for three wetland restoration projects: Mid-Barataria Sediment Diversion, Mid-breton Sound Sediment Diversion, and the Calcasieu Ship Channel Salinity Control Measures (National Oceanographic 2018). Sections 101(a) and 102 of the MMPA were waived by NMFS after a consultation with the MMC for the duration of the construction, operation, and maintenance of the projects.

Marine Mammal Stranding Network includes protocols and procedures for responding to living stranded or distressed marine mammals. Human and animal safety are considered “the top priorities” for NMFS and MMSN. Both bodies acknowledge that each situation will be unique and unforeseen circumstances will occur. In these situations, decisions will be based on recommendations found in (but not limited to) Appendix X to the PEIS, Appendix XII, Appendix XIII, Appendix XV, and Appendix XXI. These sections focus on cetacean and Pinniped Transport, Small cetacean Intervention, Euthanasia, Mass Strandings, and Small Cetacean Entanglement respectively (National Marine 2021).

Lawsuit Acknowledgement and Disclaimer

The MBSD is undergoing a multitude of legal battles, specifically facing a lawsuit from Plaquemines Parish, LA. This lawsuit, founded by Parish President Keith Hinkley, states that the CPRA did not require all necessary permits required by the National Flood Insurance Program’s federal regulations, therefore putting the residents in Plaquemines Parish in worse danger of extreme flooding due to hurricanes and other weather events. The Louisiana governor and board of trustees funding the MBSD have also come out against the project, claiming they are concerned that the CPRA does not plan on constructing the project as agreed upon, alluding to the idea that the CPRA is not being completely transparent in their agenda regarding the MBSD (Lowrey 2024). This conservation management plan was created with the idea that the MBSD will be completed, but construction is currently at a halt and appears to remain that way for some time (Lowrey 2024).

This project, and the actions laid out within, are only to be used as recommendations, not mandatory actions. The claims in this conservation management plan are based on literary

research but are not to be taken as compulsory actions. Additionally, budgetary concerns were not accounted for in this conservation management plan, and its monetary feasibility has not been evaluated. This research was conducted in Meadville, PA through online resources and personal communications with individuals involved with the MMPA and CPRA. Online research was limited, as the MBSD is a current topic of discussion and not many scientific papers focused on the impacts of this project have been published yet. Many ideal candidates for personal interviews either did not respond to my request to speak or declined to speak at all. A lack of first hand accounts of both sides of the project limited the amount of detail that could be added to this plan.

Planning Strategy for Intervention

Authorization and Training

Any and all personnel involved in dolphin-related activities within Barataria Bay must be authorized by both the NMFS and MMSN. Said activities must occur in a humane manner, while emphasizing the safety of both the animals and people involved. Additional personnel may be included in efforts if deemed necessary. These groups may include, but are not limited to, aquaria; local, state, and federal government employees; non-governmental organizations (NGOs), academia, and educated public groups in nearby communities. Additionally, internship, apprenticeship, and other assistantship roles will be created where deemed appropriate in order to train future personnel.

Previous Strategy for Development of Intervention Activities

The previous Dolphin Intervention Plan consists of three phases, each focused on a different construction period. Phase 1 plans activities for the pro-operational period, Phase 2 for both the pre-operational and post-construction periods, and Phase 3 for the post-construction period (*Dolphin Intervention Plan*). Data collection is also set to focus on entanglement and stranding responses, as well as any live animal interventions that take place.

Phase 1 covers the first 18-24 months of the pre-operational period, and focuses heavily on data collection and remote assessments. These assessments focus on a range of topics, including low salinity exposure, hydrology, biology, and dolphin welfare (*Dolphin Intervention*

Plan). Any assessments or collections of data will be carried out by subject matter experts (SMEs) that will, in time, develop recommendations for future action, as well as identify data gaps as well as how to fill these gaps (*Dolphin Intervention Plan*).

Phase 2 covers both the end of the preoperational period and 1-2 years post-construction. This phase will make an effort to investigate *T. truncatus* individuals in Barataria Bay that may be affected by low salinity as a result of the MBSD. These investigations will be known as “pilot studies” and will be based on any and all recommendations made in Phase 1 (*Dolphin Intervention Plan*).

Phase 3 covers the remainder of the post-construction period, specifically in areas with the lowest salinities in the bay (*Dolphin Intervention Plan*). This phase will begin implementing intervention activities outlined by SMEs in Phase 2.

Potential Intervention Activities

The following tiers are in order from the least amount of *T. truncatus* stressors to the most amount in Barataria Bay. Each progressing tier corresponds to worsening salinity measurements and *T. truncatus* health. Tier 1 mainly focuses on monitoring the bay and the *T. truncatus* population within it. Tier 2 continues this heavy monitoring, expands into technological advancement, and calls for the installment of remote sensors near key territory markers of *T. truncatus* within Barataria Bay. Tier 3 continues monitoring and technological advancement, and begins to install deterrence devices and starts communication with Audubon Aquarium to evaluate available manpower for potential rescue and rehabilitation efforts laid out within the final tier. Lastly, Tier 4 focuses on possible rescue and rehabilitation efforts while evaluating how to care for a sick or dying *T. truncatus* individual (i.e. translocation, in situ release, ex situ release, and euthanasia).

Tier 1

Observe the bay through a variety of monitoring techniques, including but not limited to visual observations, drone flights, boating reports, and specific dolphin-oriented research observations conducted at least 10 days per month in order for the entire area to be surveyed three full times (Sarasota 2024). As *T. truncatus* individuals are observed, a subset of data should be recorded, specifically including the date, time, location (lat, long), salinity of area found

within, and observed health condition. Salinity levels should also be monitored weekly through a combination of the multiple salinity monitoring stations located within Barataria Bay (Figure 1.0) and salinity research SMEs. Salinity measurements can be used to create additional ArcGIS Pro maps depicting suitable habitat within Barataria Bay for the *T. truncatus* population living there. Any salinity below ~8 ppt should not be considered suitable habitat (Hornsby et al 2017). These findings should be overlaid with *T. truncatus* observations in order to determine whether or not *T. truncatus* individuals are staying within suitable habitat or branching out due to salinity decreases resulting from the MBSD.

Heavy emphasis should also be placed on improving and increasing technology related to data collection and monitoring, as well as its availability. Research institutions in the process of developing satellite tags with the ability to record salinity information simultaneously should be offered a partnership or form of compensation to test these tags on the *T. truncatus* population living in Barataria Bay. One such example is the SCOUT-CTD tag developed by Wildlife Solutions, the leading provider of “advanced wildlife telemetry solutions” (Taplett 2025). This tag has been tested through years of field deployments and is currently successfully measuring and transmitting both temperature and salinity values on free-ranging marine animals (Taplett 2025). The SCOUT-CTD tag was created in response to ocean health degradation due to climate change. Because climate change is a global concern, many other organizations are looking into the development of similar tags, including NOAA and the University of Saint Andrew, an institution that received funding but ran into various roadblocks (L. Schwacke, personal communication, October 24, 2024).

Lastly, members of NMFS or MMC should begin communication with MBSD leaders and board of trustees on deposition regulations. If MBSD members cooperate with *T. truncatus* intervention activities, discussions should be focused around opening and closing the deposition gate at lengths that will benefit the marine life living within the bay. Figure 3.0 is a visual representation of salinity (ppt) in the upper Barataria Bay by Mud Lake compared to discharge (cfs) from the Mississippi River Delta. This linear regression has an R^2 value of 0.4112, meaning that 41.12% of salinity measurements in Barataria Bay can be correlated to discharge from the Mississippi River Delta (Figure 3.0). Though this result may be viewed as significant, the relationship between salinity and discharge is not completely linear due to a variety of confounding factors such as precipitation, wind, and the distance between the salinity monitoring

station and the Mississippi River Delta where data was recorded. In order to determine how the additional discharge rate of 75,000 cfs produced from the MBSD will affect Barataria Bay, the linear regression equation ($y = -15.9x + 99.625$) should be viewed as a starting point and used in conjunction with directing the opening and closing of the deposition gate. These gate movements and their lengths of time should be based on salinity levels and general health of the *T. truncatus* population, as *T. truncatus* epidermal changes, such as skin lesions, are inversely proportional to the level of salinity they are exposed to (McClain et al 2020). Understanding the relationship between *T. truncatus* health and habitat salinity will better help direct how the deposition gate should be used to appropriately meet the goals of both party interests.

Tier 2

Objectives laid out within Tier 1 should be continued at the same capacity until SMEs determine resources must be allocated elsewhere.

Remote movement sensors should be installed near major bay inlet streams to record daily *T. truncatus* movements to and from areas of the bay affected by the MBSD (Figure 2.0). Tidal inlets located in the middle and east side of Barataria Bay should be prioritized, as low salinity water from the Mississippi River naturally enters the Bay in these locations (Ou et al 2020). Inlets like these will likely experience an increase in low-salinity deposition in correspondence with the MBSD. Movement sensors should be placed in these areas to see if and when *T. truncatus* individuals are moving into low-salinity areas that may degrade their health and lead to stranding. The most efficient current model is a combination of video recordings and magnetic, angular rate, and gravity data recordings (MARG) to ensure location detection is as accurate as it can (Gabaldon, Zhang, Barton et al 2017). Zoos have had success with overhead video cameras, as well, but there are many challenges associated with moving a controlled system to a natural system, including both set up and transmission (Gabaldon, Zhang, Lauderdale et al 2022). These challenges should be addressed by SMEs in order for this technology to be implemented as early as possible, as knowing how close to the MBSD construction *T. truncatus* are travelling is a key piece to ensuring their safety. These sensors should be controlled and interpreted by SMEs, along with members of the NMFS and MMC in order to direct future decision-making. By understanding the general movement patterns of *T. truncatus*, SMEs, along

with NMFS and MMC members, can direct intervention and rehabilitation efforts to specific popular locations.

Additionally, public forums should be held in local parishes and counties to both determine public opinion of the MBSD and its effects and educate those on potentially positive and negative outcomes of the construction project. Plaquemine's Parish, a county along the west bank of the Mississippi River that will be heavily affected by the MBSD, is one of the main areas these public meetings should be held in due to their legal battle with the MBSD.

Lastly, funding should be allocated for acoustic pingers to be installed during Tier 3. These devices may be considered as extreme deterrence measures and are to be used in response to an extreme decline in *T. truncatus* health and wellbeing throughout the duration of the MBSD project.

Tier 3

Objectives laid out within Tiers 1 and 2 should be continued at the same capacity until SMEs determine resources must be allocated elsewhere.

Acoustic pingers are technological deployments often used by fishermen to deter bycatch from gillnets and other fishing equipment (Gönener 2017). Entanglement in fishing equipment, especially gillnets, is estimated to have caused the deaths of over 300,000 marine mammals, specifically dolphins, porpoises, and whales (Buratovich 2024). Acoustic pingers were developed as a way to deter these mammals, and other bycatch species, from this fishing equipment (Klinowska 1992). Pingers are small devices that emit high frequency sounds, dissuading marine mammals from coming near fishing nets at all (Stone 2000). These acoustic pingers should be installed near entrances to far-north bay inlet streams that lead to the deposition gate (Figure 2.0). This way, *T. truncatus* are deterred from the most heavily affected areas recording the lowest salinities. SMEs and data from previously installed remote sensors and visual observations will determine exactly where these pingers should be installed.

The recommended pinger is an STM product: Interactive Dolphin Deterrent Device (DiD) (STM Industrial Electronics n.d.). A minimum of 3 units should be deployed in each area while attached to set, anchored longlines (Figure 2.0). Each pinger should be 200-400 m away from the next, with a minimum distance of 600 m between DiDs and any Intermittent Dolphin Deterrent Devices (DDD) in the area (McGarry et al 2022). The DiD model is better suited to the

needs of *T. truncatus* in Barataria Bay, as it only emits high frequency noises when their presence is heard by said pinger model. These pingers can pick up the echo-localization (sonar) system used by *T. truncatus* and respond with its own deterring frequency (STM Industrial Electronics n.d.). By not emitting a constant or set intermittent noise like the DDD models, the possibility that *T. truncatus* individuals become habituated to the signals is reduced, battery charge duration is increased, and the risk of acoustic pollution is diminished (STM Industrial Electronics n.d.). No harm is done to target and non-target mammals, and fish are completely insensitive to the frequencies.

Communication with Audubon Aquarium should also begin to take place during this stage (Figure 1.0). A record of available time, space, and manpower from Audubon Aquarium and their Marine Mammal Rescue program should be created in order to determine how much funding and additional aid is needed to begin rescue and rehabilitation efforts when deemed necessary by SMEs.

Tier 4

Objectives laid out within Tiers 1 and 2 should be continued at the same capacity until SMEs determine resources must be allocated elsewhere.

Rescue and rehabilitation efforts should begin when *T. truncatus* individuals are in severe health declines. These efforts should be focused specifically on hurt young calves (and mother pairings if possible), but any *T. truncatus* individual observed to be in critical condition should be evaluated, rescued, and rehabilitated at a partnering rehabilitation center/aquarium when possible. This process involves locating the sick or injured individual, herding them to a small space near a team of rescue boats, and appropriate transportation to a rehabilitation site (NOAA 2024). When successful, Although incredibly helpful for sick *T. truncatus* individuals when successful, rescue and rehabilitation is a difficult task to complete. In-water rescues are very dangerous for both the dolphins themselves and the humans, with many dolphins known to die from unintended injury and/or high stress levels from the forceful encounter (NOAA 2024). Additionally, a very large amount of resources is needed to execute this process. The rescue of only two *T. truncatus* individuals took a team of more than 30 people (Schleifstein 2023). This rescue and rehabilitation effort was successful, but it cannot be done on a much larger scale, especially not for over 2,000 *T. truncatus*. This means that not every stranded or sick individual

will be able to be rescued, and an analysis needs to be conducted to determine whether or not a specific *T. truncatus* individual can be considered for rescue and rehabilitation. A distressed *T. truncatus* should be assessed remotely, taking into account the level of harm/distress and the probability of said harm/distress becoming worse with time instead of healing.

Once an animal's disposition is assessed and probable health trajectory is measured, one of four possible outcomes will occur: in situ release, ex situ release, translocation, and euthanasia. An in situ release means that both the *T. truncatus* individual and its habitat pass all major health requirements. These requirements include suitable salinity measurements, a medically stable individual, a socially stable individual, and the risk of future distress is low. In this instance, the animal will be tagged or marked in a unique way and released into the habitat it was originally found in. An ex situ release refers to rescue and rehabilitation efforts that have been previously outlined. In this instance, the animal will be tagged or marked in a unique way, herded, and transferred to an appropriate rehabilitation facility. A translocation refers to an animal being moved to a new site. This will occur if the *T. truncatus* individual is healthy, but its environment is not suitable for release and will not be suitable for release in the future (i.e. beach or tidal inlet stream strandings). In this instance, the animal will be tagged or marked in a unique way, herded, and transported to a new, similar site for release. Lastly, a euthanasia will only occur if a *T. truncatus* individual is on the verge of death with no recovery in sight. Many of these findings will likely be strandings that were not noticed in a short time span, leading to an irreversible deterioration of the animal's health and wellbeing. In this instance, a multitude of SMEs, including veterinarians, members of the MMC, and appropriate law enforcement, will discuss both the logistics and ethics behind euthanizing the animal. If no rehabilitation centers are open and this course of action is the most humane possible action, the *T. truncatus* individual will go through the process of euthanization.

Importance and Intended Users

This updated dolphin intervention project places a bigger emphasis on tangible and realistic intervention efforts, unlike its prior counterpart. Instead of implementing intervention policies in the post-construction period, it focuses on mitigating effects of low salinity from the MBSD while they are actively taking place. It also contains more specific instructions in regards to these intervention activities instead of simply listing potential ones. A larger focus on

community values and ethical behavior is found within this version, as well. Listening to the local population affected by this construction project is a key piece of dolphin intervention, especially in regards to visual observations. SMEs are a reliable source of information and can direct intervention efforts in the right direction, but people who have lived on the coastline of Barataria Bay their entire lives are able to provide key information SMEs may not think of during the process.

Although the low salinity conditions created by the MBSD most severely affect *T. truncatus*, this intervention plan may be used as a base template for additional dolphin species that find themselves in similar situations around the world. The MBSD is one of three current major deposition plans taking place in the United States, all attached to the Budget Act passed in 2018. This conservation management plan only focuses on the MBSD, as it is the largest of the three projects and the most destructive to animal health and welfare, but plans will likely have to be made for the additional two projects, as well, and this plan may be able to provide a template and sense of direction when the time comes.

This plan may be used as a template by NMFS, MMC, and any other major organizations involved with dolphin-related intervention activities. It may also be a framework for projects of a similar nature to the MBSD.

References

- Barataria Bay Bottlenose Dolphins*. Marine Mammal Commission. (2023, August 24).
<https://www.mmc.gov/priority-topics/species-of-concern/barataria-bay-bottlenose-dolphins/>
- Booth, C., & Thomas, L. (2021). An Expert Elicitation of the Effects of Low Salinity Water Exposure on Bottlenose Dolphins. *Oceans*, 2(1), 192. 10.3390/oceans2010011
- Born Free. (n.d.). *Why Are Bottlenose Dolphins Important?*. Born Free: Bottlenose Dolphins.
<https://www.bornfree.org.uk/animals/bottlenose-dolphins/>
- Bottlenose Dolphins: Our Smart, Sociable Stars of the Sea*. WWF. (n.d.).
<https://www.wwf.org.uk/learn/wildlife/dolphins#:~:text=Why%20dolphins%20are%20so%20important,some%20sharks%20and%20other%20creatures.>
- Buratovich, M. A. (2024). *Gill nets and drift nets*. EBSCO Information Services, Inc.
<https://www.ebsco.com/research-starters/sports-and-leisure/gill-nets-and-drift-nets>
- Carmichael, R. H., Graham, W. M., Aven, A., Worthy, G., & Howden, S. (2012). Were Multiple Stressors a ‘Perfect Storm’ for Northern Gulf of Mexico Bottlenose Dolphins (*Tursiops truncatus*) in 2011? *Plos One*, 7(7), e41155. Retrieved from
<https://doi.org/10.1371/journal.pone.0041155>
- Congress. (2022, December 26). *Marine Mammal Protection Act of 1972*. [Government]. U.S. Government Publishing Office. <https://www.govinfo.gov/app/details/COMPS-1679>
- De Guise, S., Levin, M., Gebhard, E., Jasperse, L., Burdett Hart, L., Smith, C. R., . . . Schwacke, L. (2017). Changes in immune functions in bottlenose dolphins in the northern Gulf of Mexico associated with the Deepwater Horizon oil spill. *Endang Species Res*, 33, 291-303. Retrieved from <https://www.int-res.com/abstracts/esr/v33/p291-303>
- Deming, A. C., Wingers, N. L., Moore, D. P., Rotstein, D., Wells, R. S., Ewing, R., Hodanbosi, M. R., & Carmichael, R. H. (2020). Health Impacts and Recovery From Prolonged

- Freshwater Exposure in a Common Bottlenose Dolphin (*Tursiops truncatus*). *Frontiers in veterinary science*, 7, 235. <https://doi.org/10.3389/fvets.2020.00235>
- Dolphin Intervention Plan: A framework for potential marine mammal interventions related to the Mid-Barataria Sediment Diversion Project*
<https://www.mmc.gov/wp-content/uploads/Final-Phase-II-Restoration-Plan-3-Dolphin-Intervention-Plan.pdf>
- Duignan, P.J., Stephens, N.S. & Robb, K. Fresh water skin disease in dolphins: a case definition based on pathology and environmental factors in Australia. *Sci Rep* 10, 21979 (2020). <https://doi.org/10.1038/s41598-020-78858-2>
- Gabaldon, J., Zhang, D., Barton, K., Johnson-Roberson, M. and Shorter K.A., "A framework for enhanced localization of marine mammals using auto-detected video and wearable sensor data fusion," 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Vancouver, BC, Canada, 2017, pp. 2505-2510, doi: 10.1109/IROS.2017.8206069.
- Gabaldon J, Zhang D, Lauderdale L, Miller L, Johnson-Roberson M, et al. (2022) Computer-vision object tracking for monitoring bottlenose dolphin habitat use and kinematics. *PLOS ONE* 17(2): e0254323. <https://doi.org/10.1371/journal.pone.0254323>
- Garrison, Lance P.;Litz, Jenny;Sinclair, Carrie; United States. National Marine Fisheries Service;Southwest Fisheries Science Center (U.S.) (2020). *Predicting the effects of low salinity associated with the MBSD project on resident common bottlenose dolphins (Tursiops truncatus) in Barataria Bay, LA*; United States. National Marine Fisheries Service;Southwest Fisheries Science Center (U.S.); NOAA Technical Memorandum NMFS-SEFSC ; 748 <https://doi.org/10.25923/53z9-nn54>
- Gönener, S., & Özsandıkçı, U. (2017, June 20). Technical Measures in Order to Decrease Interactions Between Dolphins and Fishermen: Pingers. *Journal of Aquaculture Engineering and Fisheries Research*.
https://www.researchgate.net/profile/Ugur-Oezsandikci/publication/317995626_TECHNICAL_MEASURES_IN_ORDER_TO_DECREASE_INTERACTIONS_BETWEEN_DO

LPHINS_AND_FISHERMEN_PINGERS/links/5a45fab20f7e9ba868a97460/TECHNICAL-MEASURES-IN-ORDER-TO-DECREASE-INTERACTIONS-BETWEEN-DOLPHINS-AND-FISHERMEN-PINGERS.pdf?_sg%5B0%5D=started_experiment_milestone&origin=journalDetail

Hornsby FE, McDonald TL, Balmer BC, Speakman TR and others (2017) Using salinity to identify common bottlenose dolphin habitat in Barataria Bay, Louisiana, USA. *Endang Species Res* 33:181-192. <https://doi.org/10.3354/esr00807>

Kellar, N. M., Speakman, T. R., Smith, C. R., Lane, S. M., Balmer, B. C., Trego, M. L., . . . Schwacke, L. H. (2017). Low reproductive success rates of common bottlenose dolphins *Tursiops truncatus* in the northern Gulf of Mexico following the Deepwater Horizon disaster (2010-2015). *Endang Species Res*, 33, 143-158. Retrieved from <https://www.int-res.com/abstracts/esr/v33/p143-158/>

Kistner, R. (2022, December 30). *In Louisiana's Barataria Bay, a coastal restoration plan will fuel a rise in painful dolphin deaths. is this the price of climate change?* . The Rocky Files. <https://therockyfiles.org/2022/12/21/in-louisianas-barataria-bay-dolphins-face-a-slow-and-painful-death-from-a-coastal-restoration-plan-is-this-the-price-of-climate-change/>

Klinowska, M., Goodson, D., & Bloom, P. (1992). Progress in the Development of Efficient Warning Devices to Prevent the Entrapment of Cetaceans (Dolphins, Porpoises, and Whales) in Fishing nets. Marine Mammals Committee: Reference Fish Capture Committee. https://www.ices.dk/sites/pub/CM%20Documents/1992/N/1992_N17.pdf

Lowrey, E. (2024, February 28). *Major coastal restoration project in Plaquemines Parish halted.* WDSU News. <https://www.wdsu.com/article/plaquemines-parish-mid-barataria-coastal-restoration-project-halted/60007494>

McClain, A. M., Daniels, R., Gomez, F. M., Ridgway, S. H., Takeshita, R., Jensen, E. D., & Smith, C. R. (2020). Physiological Effects of Low Salinity Exposure on Bottlenose

- Dolphins (*Tursiops truncatus*). *Journal of Zoological and Botanical Gardens*, 1(1), 61-75.
<https://doi.org/10.3390/jzbg1010005>
- McGarry, T., De Silva, R., Canning, S., Mendes, S., Prior, A., Stephenson, S., & Wilson, J. (2022, October). *Evidence base for application of acoustic deterrent devices (adds) as Marine Mammal Mitigation (version 4: October 2022)* 2022. Evidence base for application of Acoustic Deterrent Devices (ADDs) as marine mammal mitigation (Version 4: October 2022) | JNCC Resource Hub.
<https://hub.jncc.gov.uk/assets/e2d08d7a-998b-4814-a0ae-4edf5d887a02>
- Mid-barataria*. MBSD. (n.d.). <https://midbasin.coastal.la.gov/mid-barataria>
- Mullin, K. D., McDonald, T., Wells, R. S., Balmer, B. C., Speakman, T., Sinclair, C., . . . Schwacke, L. H. (2017). Density, abundance, survival, and ranging patterns of common bottlenose dolphins (*Tursiops truncatus*) in Mississippi Sound following the Deepwater Horizon oil spill. *Plos One*, 12(10), e0186265. Retrieved from
<https://doi.org/10.1371/journal.pone.0186265>
- National Marine Fisheries Service. (2022, May). COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*) Barataria Bay Estuarine System Stock.
https://media.fisheries.noaa.gov/2022-08/Com Bottle Dolphin-Barat Bay Est Sys Stock_SAR 2021.pdf
- National Oceanic and Atmospheric Administration. (2018). *Waiver of Requirements Under Sections 101(a) and 102(a) of the Marine Mammal Protection Act (MMPA) for the Mid-Barataria Sediment Diversion, the Mid-Breton Sound Sediment Diversion, and Calcasieu Ship Channel Salinity Control Measures Projects*. The Federal Register.
<https://www.federalregister.gov/documents/2018/03/21/2018-05652/waiver-of-requirements-under-sections-101a-and-102a-of-the-marine-mammal-protection-act-mmpa-for-the>
- NOAA Fisheries: Southeast, National. (2024, June 21). *Displaced dolphins: Post-hurricane response*. NOAA.
<https://www.fisheries.noaa.gov/marine-life-distress/displaced-dolphins-post-hurricane-res>

ponse#:~:text=and%20Fenstermaker%20LLC-,A%20Coordinated%20Response,possible%20at%20a%20later%20date

Ou, Y., Xue, G. Z., Li, C., Xu, K., White, J. R., Bentley, S. J., & Zang, Z. (2020, September 20). A numerical investigation of salinity variations in the Barataria estuary, Louisiana in connection with the Mississippi River and restoration activities. *Estuarine, Coastal and Shelf Science*.

<https://www.sciencedirect.com/science/article/abs/pii/S0272771420307526>

Sarasota Dolphin Research Program. (2024, June 27). *Uncovering the secret lives of dolphins*. <https://sarasotadolphin.org/secret-lives/>

Schleifstein, M. (2023, August 6). *Dolphins at risk from Louisiana's biggest ever coastal project. this plan might save some*. NOLA.com.

https://www.nola.com/news/environment/dolphin-rescue-plan-ramped-up-ahead-of-3-billion-diversion/article_754e1568-2d4c-11ee-854e-bfc996582e85.html

Schwacke, L. H., Smith, C. R., Townsend, F. I., Wells, R. S., Hart, L. B., Balmer, B. C., . . . Rowles, T. K. (2014). Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the Deepwater Horizon Oil Spill. *Environmental Science & Technology*, 48(1), 93-103. 10.1021/es403610f

STM Industrial Electronics. (n.d.). *Dolphin Deterrent Devices*. Dolphin deterrent devices > STM products.

<https://www.stm-products.com/en/products/fishing-technology/dissuasori-per-delfini-green/did-01~54.html>

Stone, Gregory S., Cavagnaro, Laura, Hutt, Alistair, Kraus, Scott, Baldwin, Kenneth, Brown, Jennifer (December 2000). Reactions of Hector's dolphins to acoustic gillnet pingers. *Department of Conservation*.

<https://www.doc.govt.nz/globalassets/documents/science-and-technical/csl3071.pdf>

Takeshita, R., Balmer, B. C., Messina, F., Zolman, E. S., Thomas, L., Wells, R. S., . . . Schwacke, L. H. (2021). High site-fidelity in common bottlenose dolphins despite low salinity

exposure and associated indicators of compromised health. *PLoS One*, 16(9)
doi:<https://doi.org/10.1371/journal.pone.0258031>

Taplett, N. (2025, February 5). *Promising field trial results: Prototype scout-CTD tags transmit thousands of temperature and salinity profiles - Wildlife Computers Inc.*. Wildlife Computers Inc. - Innovative Tags for Innovative Research.
<https://wildlifecomputers.com/blog/promising-field-trial-results-prototype-scout-ctd-tags-transmit-thousands-of-temperature-and-salinity-profiles/>

Thomas, L., Marques, T. A., Booth, C., Takeshita, R., & Schwacke, L. H. (2022). Model predicts catastrophic decline of common bottlenose dolphin (*Tursiops truncatus*) population under proposed land restoration project in Barataria Bay, Louisiana, USA. *Marine Mammal Science*, 38(4), 1654–1664. <https://doi.org/10.1111/mms.12930>

University of Central Florida Physiological Ecology and Bioenergetics Lab. (n.d.). *Bottlenose dolphin distribution patterns and habitat utilization*. Physiological Ecology and Bioenergetics Lab.
<https://sciences.ucf.edu/biology/PEBL/current-research/marine-vertebrate-feeding-ecology-and-habitat-utilization/bottlenose-dolphin-distribution-patterns-and-habitat-utilization/>

U.S. Army Corps of Engineers. (2022). *Draft EIS for the proposed MBSD Project*.
https://www.mvn.usace.army.mil/Portals/56/docs/regulatory/permits/EIS/MBSD_DEIS_Executive_Summary.pdf

USGS Water Resources. (n.d.a). *Barataria waterway at Mud Lake S of Lafitte, LA*. Barataria Waterway at Mud Lake S of Lafitte, LA - USGS Water Data for the Nation.
<https://waterdata.usgs.gov/monitoring-location/073802511/#dataTypeId=continuous-00065-0&period=P7D&showMedian=false>

USGS Water Resources. (n.d.b). *Mississippi River at Belle Chasse, LA*. USGS Water Data for the Nation.
<https://dashboard.waterdata.usgs.gov/api/gwis/2.1.1/service/site?agencyCode=USGS&siteNumber=07374525&open=167809>

- Wells, R. S., Schwacke, L. H., Rowles, T. K., Balmer, B. C., Zolman, E., Speakman, T., . . . Wilkinson, K. A. (2017). Ranging patterns of common bottlenose dolphins *Tursiops truncatus* in Barataria Bay, Louisiana, following the Deepwater Horizon oil spill. *Endang Species Res*, 33, 159-180. Retrieved from <https://www.int-res.com/abstracts/esr/v33/p159-180/>
- Wilson B., Arnold H., Bearzi G., Fortuna C. M., Gaspar R., Ingram S., Liret C., Pribanic S., Read A. J., Ridoux V., Schneider K., Urian K. W. , Wells R. S., Wood C., Thompson P. M. and Hammond P. S. (1999). Epidermal diseases in bottlenose dolphins: impacts of natural and anthropogenic factors *Proc. R. Soc. Lond. B*.2661077–1083