UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

# UNCERTAINTY, POLICY IMPLEMENTATION, AND THE 2012 LOUISIANA COASTAL MASTER PLAN

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

Degree of

DOCTOR OF PHILOSOPHY

By

VIRGINIA G. SILVIS

Norman, Oklahoma

2020

UNCERTAINTY, POLICY IMPLEMENTATION, AND THE 2012 LOUISIANA COASTAL MASTER PLAN

A DISSERTATION APPROVED FOR THE

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL SUSTAINABILITY

BY THE COMMITTEE CONSISTING OF

Dr. Travis Gliedt, Chair

Dr. Mark Meo, Co-Chair

Dr. Darren Purcell

Dr. Scott Robinson

Dr. Mark Shafer

DEDICATION

To Fannie, who chose the road,

and to Zelda and Grace who built it.

ACKNOWLEDGEMENTS

I want to express my sincere thanks and gratitude to both of my advisors, Dr. Mark Meo and Dr. Travis Gliedt. Your encouragement, words of wisdom, and guidance have been instrumental in helping me explore the fields of geography and public policy analysis and develop my skills as a researcher. You helped a social science-curious meteorologist become the social scientist I am today, thank you! I also want to thank the other members of my committee, Dr. Darren Purcell, Dr. Scott Robinson, and Dr. Mark Shafer for their thoughtful comments and edits on this dissertation and their advice throughout this process.

Another huge thank you goes to the staff of the Department of Geography and Environmental Sustainability, both past and present, for their support and help in navigating the hurdles of completing a Ph.D.

I want to thank my parents, Tom and Sharon Silvis, for their love and support, and for not laughing at me when I announced precociously as a five year old that I wanted to get a Ph.D. Instead they encouraged what became a life-long love of reading and learning, as well as instilling in me the importance of doing something to make the world a better place. I hope these small efforts can contribute to that cause.

Lastly, but by far not the least, I want to thank my husband and partner in crime for the last 18 years, Michael Hunter. You have been my sounding board, my writing critic, and my biggest cheer leader during this entire process. Without you, this dissertation would have never have been finished. Team Silter for the win!

ABSTRACT

The 2012 Coastal Master Plan is the first iteration of the on-going coastal master planning process the state of Louisiana is implementing in an effort to reduce and/or prevent the loss of valuable wetlands along the state's southern coast. Residents of the region face increasing flood risks from the Gulf of Mexico due to the loss of surge reduction capacity of the eroded wetlands and from rising sea-levels due to climate change. The 2012 plan represents the first time Louisiana has linked coastal restoration with flood prevention, but many uncertainties regarding implementation of the plan remain. There is not a systemic understanding of the implementation process from the literature. Instead, multiple strategies for environmental policy implementation under uncertainty have been developed. The Coastal Protection and Restoration Authority (CPRA), the state agency developing and implementing the plan, has selected adaptive management as its implementation strategy for managing uncertainty, a strategy with a troubled history of transitioning from theory to practice.

This dissertation investigates areas of uncertainty with the 2012 Coastal Master Plan as well as framework fidelity to the selected management strategy of adaptive management. A research triangulation approach was used, with a review of the environmental history of coastal erosion in Louisiana, document analysis of local newspapers, and interviews with stakeholders involved with the master planning process being the sources of data. The main findings are that fundamental issues exist around the state's implementation of adaptive management thus far and that scientific and financial uncertainties are tightly linked. Adaptive management is poorly understood by stakeholders and mostly absent from local public discourse despite being critical for successful implantation of the master plan. Scientific uncertainty is leading to an entrenched

conflict regarding the impacts of a major plan component, controlled sediment diversions. Given the framework fidelity issues found, it is unlikely that CPRA will see the expected learning and reduction in scientific uncertainty promised by adaptive management. Scientific and financial uncertainties were also found to be tightly linked in Louisiana, with the state possessing very limited funding for plan and uncertain avenues to secure further restoration funds. Louisiana cannot be perceived as wasting or misusing these resources, and scientific uncertainty in relation to projects within the master plan results in a catch-22 scenario where the state can only mitigate scientific uncertainty if financial uncertainty has already reduced, which is not possible until scientific uncertainty is mitigated, a situation not accounted for in the environmental policy implementation strategies, including adaptive management.

TABLE OF CONTENTS

# Chapter 1: Introduction

Scientific research has exploded in both scope and funding since the beginning of the post WWII era, leading to new inventions, manufacturing processes, medical cures, and generally improving the quality of life for the billions of people on this planet. Along with that progress there has also been an increase in environmental problems that affect the air we breathe, the water we drink, and even the stability of the land on which we live. The same ethos that led to the expansion of scientific research has also led to many scientific investigations into these environmental problems, with the belief that solutions can be found through science. Paradoxically though, it has seemed over the last few decades that environmental problems have become more frequent and with some appearing unsolvable. The combination of greater awareness of the impact of industrialization on the environment, combined with new technology creating new, unforeseen problems, has led to this overall increase in environmental problems, despite efforts to stem the tide.

With complex scientific or technical advances, scientific uncertainty is frequently present in some capacity. Sometimes this is caused by our ignorance despite the best of intentions, through creating a solution to one problem a larger, more harmful problem is created. Examples of this are the creation of the dead zone in the Gulf of Mexico due the widespread use of chemical fertilizers to replenish the soil fertility in the Great Plains or the inadvertent biocide caused by pesticides like DDT. Other times we are aware of the uncertainties present, but decisions must be made before scientific uncertainty can be resolved. Contentious debates can arise in these situations as policy makers must determine what the best course of action is, and advocacy groups coalesce to try to influence choice selection. This is especially true in cases where environmental problems impacting humans are identified, often solutions must be

determined and implementation begun with uncertainties present. Rarely are science policies considered to be successful without accounting for the inherent uncertainty in some fashion, leading to those working at the science-policy interface to develop strategies for managing uncertainty during implementation.

This study focuses on one such large environmental problem: the disintegration of the state of Louisiana's southern coastline into the Gulf of Mexico, and the implementation of the policy solution the state has devised to solve this problem, its coastal master planning process. This process is anchored by the state's coastal master plan document, which was first issued in 2007, and has been updated every five years to include recently discovered scientific information and projects based on updated funding availability. The 2012 Coastal Master Plan will be the main focus of this work as it is considered to be "retired" and no longer guiding the state's coastal erosion fight. This study looks at the public conversation around coastal erosion during the time period the 2012 Coastal Master Plan was in effect, as documented in local newspapers, and the perceptions of professionals involved with the coastal master planning process in Louisiana to assess how two areas of uncertainty related to the implementation of the plan, scientific uncertainty and the uncertainty of the funding availability, are being reduced or, given the environmental history of the state, enhanced. If Louisiana fails to deal with these uncertainties during implementation, it could result in the coastal master planning efforts making the environmental situation worse.

## Relevance and Importance

The state of Louisiana and the federal government of the United States have a long history of trying to control flood waters from riverine and atmospheric sources across the state (Barry 1997; O'Neill 2006; Colten 2009; Klein and Zellmer 2014). Recent hurricane disasters have demonstrated that there is still considerable work to be done (Cooper and Block 2006; Daniels et al. 2006; Thibodeaux 2012). This raises the question then of why Louisiana has struggled so much with flood control when it has been engaging with this particular problem for as long as humans have been living in the state. The levee failures during Hurricane Katrina in 2005 spectacularly demonstrated the scope of the flooding problem for southern portions of the state, and have led to a veritable flood of published material in newspapers, congressional testimony, academia, and the blogosphere related to the need for improved flood control in the region. The hurricane disasters of 2005 also exposed another problem, the disintegration of the southern coastline of Louisiana (CPRA 2007; Houck 2015). Many hundreds to thousands of square miles of wetlands that had served in the past as an ecological buffer against storm surge have disappeared over the last few decades, leaving the residents of the state far more exposed to flooding than they had previously realized. Many have called for improved scientific knowledge to be incorporated into the policy making process on the related issues of coastal restoration and flood control. The assumption is that this will lead to better policy outcomes for the state (Pielke 2007).

Science is not infallible though. Many Americans today view science as a "black box"; they do not understand the process that produces scientific information (Ungar 2000; Neal et al. 2008; Firestein 2012), which makes it difficult for many to understand how science impacts their lives and the uncertainties associated with scientific research. Since science is typically thought

of as a public good (Callon and Bowker 1994; Neal et al. 2008), it is frequently invoked as justification for policy decisions, including ones that are based more on values than science. If the public does not understand the process of science, how new information is generated through the scientific method and peer-review processes, they are likely to misunderstand differences between scientific debates and debates on values. It also makes it more challenging for members of the public to participate in the process directly when asked by scientists or public officials, such as through public comment on proposed plans or policies, or if they choose to seek elected office. Over the course of the twentieth and twenty-first centuries, information generated by the physical or social sciences has had an expanding influence on public policy making as a result of a broad push for data-driven decision-making in government, from redistributive policies concerning funding for clean drinking water to proposals for pollution taxes for industries and individuals (National Research Council 2012). The public is affected by science more today than at any point in history, making it important that they understand how that knowledge is generated and used in order for the public to be an active participant in the policy process. If they do not understand how science is impacting their lives every day, they may support policies or politicians that are not in their long term best interests.

The scientific illiteracy of the public also leads to the possibility that the concept of science is being used to lend legitimacy to policies and decisions that are not actually based on science, but instead on other factors or values (Pielke 2007; Oreskes and Conway 2010; Beck 2011). This is evident in policy debates where both sides of an issue attempt to use science, or the concept of science, to justify their positions (Pielke 2007; Oreskes and Conway 2010; Balint et al. 2011). This use of science as justification is the result of the hegemonic construct that better

or more scientific knowledge will lead to better decision-making (Sarewitz 2004; Pielke 2007; Beck 2011). This is rarely true, but the simplicity of the construct appeals to scientists seeking to make their research policy relevant without involving themselves directly in political decision-making and to policy-makers looking for easy justification of why their particular policy is the correct choice (Sarewitz 2004; Pielke 2007).

Louisiana has a history of producing either science-based plans for dealing with the coastal erosion problem, dating back to the 1980s with the publication of *Coastal Louisiana: Here Today and Gone Tomorrow,* or science-based task forces to do much the same. All these efforts have led to some success, as seen with the passage of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) by the US Congress in 1990 and the associated funding that has allowed for the implementation of many coastal restoration projects in coastal Louisiana. Those successes have not been enough to stop the coastline of the state from eroding away due to the fragmentary nature of the projects implemented and an inadequate budget for the scale of the problem, leaving the people living and the infrastructure built there increasingly vulnerable to flooding. After the disasters of the 2005 Atlantic hurricane season, top Louisiana officials, including then Governor Kathleen Blanco, vowed that moving forward from that year the state would handle the intertwined problems of coastal erosion and flood control differently.

This vow led to the passage of Act 8 by the Louisiana State Legislature in November of 2005 that created the Coastal Protection and Restoration Authority (CPRA) and the state-level coastal master planning process as it is known today (CPRA 2007). The first plan, produced in 2007, was considered to be a place holder indicating the state's intentions to produce a coastal master plan by 2012 as many state resources were still involved with the recovery from

Hurricanes Katrina and Rita in 2005 (CPRA 2007). The 2012 Coastal Master Plan was hailed as an innovative document for the state, the first time the state had combined ecosystem restoration and flood protection as well as listing specific projects to accomplish those goals. One local scientist, Dr. Paul Kemp, when asked about the new plan was quoted by *The Advocate* as saying, "I've worked on past plans, and they weren't worth the paper they were written on" (Advocate Editorial Board 2012). He went on to say of the plan that it was composed of proven strategies for fighting coastal erosion and that, "the good news is that we can actually reverse land loss" (Advocate Editorial Board 2012).

The rosy view portrayed to media belied some serious concerns with the 2012 plan, chief among them that plan itself was not funded. The 2012 Coastal Master Plan was estimated to cost roughly $50 billion, an amount of money the state of Louisiana did not have at the time. Others were concerned that the Master Plan did not hold the oil and gas industry financially or legally accountable for their part in the coastal erosion crisis, which ultimately led to the to the 2013 lawsuit filed by the Southeast Louisiana Flood Protection Authority - East to do just that. There were also serious questions about the scientific information being included in the plan. Controlled sediment diversions on the scale included in the project have never been constructed or operated before in Louisiana or elsewhere in the world, and the land building estimates included in the Master Plan were based on computer models, not actually implemented projects in existence. The computer models were built in part from information learned during the operation of two freshwater diversions off the Mississippi River, Davis Pond and Caernarvon, to help control salinity levels. These two existing diversions were designed to minimize the sediment load of the water that passed through them. Other large scale restoration projects, such

as the Dutch Sand Engine, following a similar "building with nature" style approach as the proposed sediment diversions, have been constructed and operated, but relied on more recent relevant data and smaller scale analogs to inform modeling efforts (see Taal et al. 2016). Another type of project absent from the plan is backfilling the existing canals dug by the oil and gas industry. Backfilling is a well known, successful, and cost-effective technique to restore marshes damaged by oil and gas canals (Neill and Turner 1987; Turner et al. 1994a; Turner et al. 1994b; Baustian and Turner 2006; Baustian et al. 2009; Turner and McClenachan 2018) but this technique was not included in the plan, with some believing the exclusion was to protect oil and gas interests from potential damage claims (see Houck 2015). This lends credence to concerns that the planning process is not as apolitical as it claims to be and that the state of Louisiana has not truly changed its behavior when responding to environmental problems.

These same concerns are likewise valid for the implementation of the coastal master plan. The implementation of the plan, and how the uncertainty inherent to several facets of the plan is dealt with, during the period of time it is in effect will also be crucially important to the overall effectiveness of coastal restoration efforts. The ultimate success of a policy goes beyond the challenges of getting it through a legislature and voted into law, it is the result of how the policy is implemented, and the annals of implementation literature chronicle policies that failed during implementation, such as the recent American Patient Protection and Affordable Care Act (May 2015) to the Oakland Project of the late 1960s (Pressman and Wildavsky 1984). The CPRA has been publishing regular annual reports detailing the progress and/or completion of projects related to coastal restoration, but these reports do not deal with the scientific uncertainties related to coastal ecosystem knowledge and the human uncertainties related to funding and political

support that would affect implementation. There can be major problems even when a policy is well funded for implementation, as was the case with the Oakland Project. Pressman and Wildavsky showed in their (1984) book that even when there is political will and funding to do "big" things, if the uncertainties related to the project are not adequately resolved during implementation little action will actually occur. Since the publication of the 2012 plan, the state of Louisiana has managed to secure funding to construct some, but not all of the proposed projects in the plan, and there are still questions about the longevity of current funding resources for operation of constructed projects. Louisiana and the CPRA are in a similar position as the Economic Development Administration was in the 1960s: there is political will to tackle the state's coastal erosion crisis and some of the funding needed to do so, but uncertainties remain.

Scientific uncertainty will play an important role in implementation as the coastal master plan documents acknowledge that learning about the coastal ecosystem of southern Louisiana will occur during implementation, and they plan to incorporate any new knowledge generated into an on-going planning process through the strategy of adaptive management (CPRA 2007; CPRA 2012; CPRA 2017). Scientific uncertainty may be a double-edged sword for CPRA. It can result in new knowledge being gained that when incorporated back into the planning process through an adaptive management strategy can result in improved long-term outcomes. The same uncertainty can also result in what seemed like a promising restoration project in a computer model becoming not as promising when constructed and operating in practice.

There have been few studies looking at the Louisiana Coastal Master Plan (see Reed and Peyronnin 2013, Gotham 2016; Knox 2017), with only one, Gotham (2016) actually interviewing some of the stakeholders being affected by the plan, primarily stakeholders from the

fishing community concerned about the effects of the proposed sediment diversions. The focus has predominately has been on the computed models and scenarios incorporated into the plan documents (see Reed and Peyronnin 2013). The human side of the human-environment equation for this policy has not been well studied. This study aims to fill some of that gap by exploring how local media are representing uncertainty relating to one iteration of the plan, the 2012 Coastal Master Plan, and how stakeholders involved in the coastal master planning process view the uncertainty in the implementation process.

## Study Objectives

This study concerns how uncertainty is being alleviated through the implementation of the 2012 Coastal Master Plan, one iteration of the coastal master planning process in Louisiana. A research triangulation approach was used to better identify overall themes across this study, with a review of the environmental history of coastal erosion in Louisiana, document analysis of local newspapers, and interviews with stakeholders involved with the master planning process being the sources of data. To that end, this study examined public discourse around the two areas of greatest uncertainty with the 2012 Coastal Master Plan: its scientific underpinning and its funding. The public discourse was indicated by document analysis of local newspaper articles.

For the document analysis of local newspaper articles published while the 2012 plan was in effect I wanted to answer the following questions:

1) How do major local newspapers broadly cover science and funding related to the master plan?

2) How are the specific scientific topics of climate change and sediment diversions represented in the local newspapers?
3) How is the specific lack of funding for the master plan covered by the local newspapers?

Stakeholders' views were assessed with 60-minute semi-structured interviews. For the stakeholder interviews, I wanted to determine what they viewed as important areas of uncertainty, scientific, financial, or political, that need to be resolved for the 2012 plan to be successful. As this is an exploratory study of the perceptions on the implementation of the master planning process by publicly identified stakeholders participating in that process, I was interested in the general themes that existed within the interview data around uncertainty, adaptive management, and stakeholder scientific literacy.

## Overview of Dissertation Structure

Chapter 2 will present a review of the relevant literature regarding policy implementation when scientific uncertainty is present. Chapter 3 covers the recent (20th through 21st centuries) history of the coastal erosion and flooding issues in southern Louisiana. Chapter 4 presents the qualitative content analysis and thematic analysis methodologies used in this study, while Chapters 5 and 6 dive into the analysis of the documents and the interviews conducted respectively. Chapter 7 concludes this study as well as discussing the limitations of this work and future research.

# Chapter 2: Literature Review

**The Science-Policy Interface**

In the late nineteenth/early twentieth centuries there was as shift by public policy makers to look to scientists to help solve a wide variety of societal problems (Oppenheimer et al. 2019). Many of the original problems were themselves the consequences of the modernization of society due to improved technology and scientific information. Science had begun to be defined as a specialized activity requiring certain types of usually academic or professional training. As this perception grew, scientists as a group began to be viewed by many, but especially policy makers, as a group with the correct specialized knowledge to provide advice about the increasingly complex and technological world where scientific issues like vaccinations and machine safety were becoming important public policy issues. After World War II, funding for science by the U.S. federal government grew exponentially as a result of the success of scientists helping the Allies during that war, the start of the Cold War, and the Space Race (Neal et al. 2008; Douglas 2009). Science and policy became more and more intertwined as the relationship between science and government strengthened.

In recent years, many scientists have been working to engage with policy makers to help them solve political problems caused or influenced by science. This is especially true of environmental problems as they can have widespread, dangerous consequences if ignored. Unfortunately though, as the amount of knowledge around environmental problems has grown, particularly with respect to climate change, so have controversies surrounding how to respond to these problems. This resistance from some quarters to proposed changes usually advocates a retrogressive turn back to the belief/assumption that the environmental problem either does not exist or is not as problematic as what scientists claim. As Sarewitz (2004) points out, this should

not have been unexpected as the focused expansion of specific areas of scientific literature, usually done to help resolve political dispute and allow for effective and informed decision-making, has often resulted in increased political controversy and gridlock, the very things that adding to the scientific literature was supposed to prevent.

Not helping the matter is that a majority of the public today is scientifically illiterate and cannot grasp more than a simple recognition of a scientific issue and maybe understand a few of its underlying supports (Ungar 2000; Neal et al. 2008; Sinatra and Hofer 2016), so they are unable by themselves to sort fact from pseudoscience fiction regarding environmental problems. The public sometimes cannot see that debates about the "science" are more frequently just proxies for debates about values (Beck 2011; Oppenheimer et al. 2019), and that scientists struggle to understand how value-driven their adversaries are (Sarewitz 2004). The field of science is ill-prepared to compete in the attention economy that comprises most of popular culture as few scientists are charismatic communicators capable of holding the public's attention (Ungar 2000) making it difficult for those few to correct false information. An example of a scientist attempting to do so is Oreskes' (2004) essay on the scientific support for climate change in the journal *Science*, and while the article is concise and well-written, it is published in an academic journal that despite its high impact factor does not have the same public reach as other sources like national newspapers and popular magazines.

There are several assumptions about how science can influence policy that underpin many scientists' approach to dealing with public policy. The most significant is the linear model of scientific expertise, where the interactions between science and policy are a one-way street that flow from more scientific information leading to less uncertainty about policy choices,

which leads to political action (Pielke and Byerly 1998; Pielke 2007; Beck 2011). Three propositions back up this linear model: (1) more research will reduce uncertainty, (2) better science will help solve political disagreements since science is a harmonizing force, and (3) science makes polices more rational and evidenced-based *because* it strenuously avoids getting involved in political arguments (Pielke 2007; Beck 2011). These propositions are flawed as increased scientific knowledge often expands uncertainty as much as it occasionally decreases it, and, as mentioned earlier by Sarewtiz (2004), more science does not axiomatically lead to fewer conflicts, instead it tends to provide fuel to the fire of public debate. The linear model of scientific expertise also has the paradoxical effect of tending to politicize science while at the same time depoliticizing polices (Beck 2011). Lastly, proposition one is particularly harmful because in many instances it is used to justify delaying action in favor of more research on the grounds of there being too much uncertainty, whether it is true or not (Bradshaw and Borchers 2000; Sarewitz 2004; Aklin and Urpelainen 2014).

The claim of being able to avoid political debates is a consequence of the belief that science is a value-less field, independent of ideology (Sarewitz 2004; Pielke 2007; Douglas 2009; Beck 2011), which is not the case. Far from being independent, scientific knowledge is co-produced by scientists and the society the scientists are members of, and it is dependent on the political context of that society as well (Jasanoff 1996; Douglas 2009). The same scientific facts can be combined to support multiple different explanations of what is happening, as well as multiple recommendations for how to address the problem, depending on the disciplinary lens one looks through (Sarewitz 2004).

Policy makers want science to narrow the policy options to make their correct choice clear, whereas scientists are apt to provide them with probabilities, uncertainties, and different scenarios (Sprujit et al. 2014), all of which can be open to interpretation. The studies that influence policy makers the most are those that advocate incremental changes, are not controversial, used relatively simple methods, and provide information that is timely and relevant (Greenberg and Mandel 1991). For many scientists though, the goal is to be "policy relevant" with their research, not "policy prescriptive" (Oppenheimer et al. 2019). They believe that in order to be seen as objective, and thus trustworthy and credible as policy advisors, they must remain policy neutral, providing information but not making recommendations on policy decisions using that information (Oppenheimer et al. 2019). This is an almost impossible task due to the murky border that exists between science and policy in the twenty-first century, especially in the realm of environmental policy. Many of the questions of environmental policy are variations of "How bad is this problem and how rapidly does it need to be addressed?" These are questions that must be answered with science and scientists are often asked to make informed judgements based on the research they have done, leading to the murky borderlands between the two disciplines (Oppenheimer et al. 2019).

In line with the need to be more specific about policy prescriptions, there also needs to be a shift from solely problem-focused research to the inclusion of some policy-focused research as well (Beck 2011). Including policy-focused research into research programs would provide an avenue for decision-makers to examine the policy implications of the different scenarios and determine what the best courses of action would be to increase their adaptive capacity and reduce their vulnerability (Beck 2011). It also allows for decision-makers to begin to take some

ownership of the problem and gives them more of a stake in trying to find solutions, which could lead to the decision-makers themselves coming up with innovative new solutions that had not been previously considered (Beck 2011).

Scientists also need to acknowledge that science alone cannot answer all questions regarding complex and uncertain risks and problems, so science practitioners themselves should try to be as transparent about their own values and viewpoints as possible (Sarewitz 2004). Most likely this would have been an illuminating exercise in professional humility for many (Beck 2011), but it would allow them to participate more fully and honestly in the policy making process where their expertise could be beneficial (Oppenheimer et al. 2019). Though scientists tend to shy away from this level of transparency due to the belief in their being perceived as objective if they remain policy neutral, there is little evidence that they will lose credibility by doing so (Oppenheimer et al. 2019). Much of the controversy surrounding many environmental policy problems is due to the values scientists' hold not being made clear, which has allowed critics with an alternate agenda to promote half-truths in their stead. This can also result in the obfuscation of what is really a debate about the values underlying a policy by making it appear that the issue is the "faulty" foundation of elements of the science (Pielke 2007; Oppenheimer et al. 2019). Only by bringing the values, and the conflicts that they cause, into the fore will it possible to begin moving past the controversy and on to successful political action and responses (Jamieson 1992). This type of 'sunshine' would make it extremely difficult for politicians to continue to hide behind scientific uncertainty as a way to avoid making tough, complex decisions; the onus of explanation would now be with the politician to explain their inaction, not with the scientific community (Sarewitz 2004).

The scientific community in general also needs to accept and admit that the linear model of scientific expertise does not work that well in today's world, if it ever truly did (Pielke and Byerly 1998; Sarewitz 2004; Pielke 2007). As an extension of this, scientists need to recognize that the organization of science is not a harmonizing force, and instead it is a very dynamic catalyst for political disputes (Sarewitz 2004). More scientific information is not going to resolve the disputes, nor will it change the minds of skeptics here in the United States that are resistant to change for various political or economic reasons (McCright and Dunlap 2011). The path to resolving those disputes and changing the hearts and minds is not going to be found in the solely in the theories and knowledge of the physical sciences.

**Implementation**

Beyond agenda setting or policy selection, scientists are also needed during the implementation process for science policies, the point where policy success or failure is often made. A well-designed policy can still fail to be effective if the implementation of said policy goes astray, either unintentionally or on purpose, or if there is a lack of funding to implement the policy at all. Policy implementation, in a general sense, is the process between policy expectations and the outcomes the policy actually achieves (Ferman 1990). This is the step where the agencies and bureaucrats charged with implementing a policy determine how they are going to do so, or stop doing so if that is the charge of the policy, hence it being the source of success or failure for a policy (O'Toole 2000; Smith and Larimer 2013). Formal adoption of a policy typically does not include any solid direction on how to translate policy into action (Mazmanian and Sabatier 1983; Smith and Larimer 2013). The study of policy implementation is a relatively

recent area compared to other areas within political science, with in depth study considered by many to have truly begun in the early 1970s with Martha Derthick's (1972) study and Jeffrey Pressman and Aaron Wildavsky's seminal (1973) book.

Given the complex nature of policy implementation, systemic understandings of the field have been illusory at best. In search of overarching theory, policy implementation studies have transitioned through three "generations" of scholarship since the 1970s (Goggin et al. 1990; deLeon and deLeon 2002). During the first generation of implementation scholarship, the focus was on promoting implementation research as a valid arena of study, and that it may be possible to develop a systemic understanding of the causes and related effects that occur during the implementation process (Smith and Larimer 2013). It focused primarily on case studies that charted the path of a policy from definition through to execution (deLeon and deLeon 2002). The two books mentioned previously, Derthick's *New Towns, In-Town: Why a Federal Program Failed* and Pressman and Wildavsky's *Implementation: How Great Expectations in Washington Are Dashed in Oakland; or, Why It's Amazing that Federal Programs Work at All, This Being a Saga of the Economic Development Administration as Told by Two Sympathetic Observers Who Seek to Build Morals on a Foundation* are considered as foundational works of this era (Goggin et al. 1990; deLeon and deLeon 2002; Smith and Larimer 2013). Both are descriptive rich case studies of federal-level policies that identify key lessons to be learned in future implementation work, that not enough thought and attention was being given to the implementation process given how crucial it was to policy success, but they only hinted at a general theory of implementation.

The second generation of implementation scholars pushed the field from case studies to trying to develop the elusive general theory, or theories, of implementation while acknowledging how complex the process is. From this era came competing implementation theories: the "top-down" approach (e.g., Berman 1980; Nakamura and Smallwood 1980; Mazmanian and Sabatier 1983) and the "bottom-up" approach (e.g., Lipsky 1980; Hjern 1982; Hjern and Hull 1983) (deLeon and deLeon 2002; Smith and Larimer 2013). The "top-down" approach to implementation had a command-and-control orientation where the behaviors of the implementers in the process was not considered to be as important to the process as those that created the policy (deLeon and deLeon 2002; Smith and Larimer 2013). The focus instead was on the independent and dependent variables involved in the implementation process that would affect the objective or goal of the policy (Mazmanian and Sabatier 1983; deLeon and deLeon 2002; Smith and Larimer 2013). Conversely, the "bottom-up" approach focused on the street-level bureaucrats that the "top-down" approach had lumped in the periphery of that framework, such as teachers, social workers, or police officers, the people who actually had to implement a policy (Lipsky 1980; deLeon and deLeon 2002; Smith and Larimer 2013). This approach argued that the focus of implementation studies must include those at this street-level that are tasked with implementation in order to determine if policy objectives could be adapted to local conditions on the ground, and that by excluding them from the policy formation process or including them only once the policy had been decided/passed then the policy was at higher risk of failure (Lipsky 1980; deLeon and deLeon 2002; Smith and Larimer 2013). Moving past this theoretical conflict are those that felt both approaches were useful, with those in the "top-down" group focusing on policy outcomes and taking a rationalist approach to determine testable casual relationships and

the “bottom-up” group typically using a more post-positivist lens to bring previously unrepresented voices into the implementation process (deLeon 1999).

Building on the work from the previous two generations, the third generation of implementation scholarship debuted at the beginning of the last decade of the twentieth century with a call to be more scientific in the approach to studying implementation (Goggin et al. 1990; deLeon and deLeon 2002; Smith and Larimer 2013). Acknowledging the complexity inherent to implementation, the focus of this generation of research was on developing and testing causal hypotheses and through this work a general theory of how policy did, or did not, work would be determined (deLeon and deLeon 2002; Smith and Larimer 2013). By the end of the decade, many policy scholars were lamenting the “death” of policy implementation studies due to the difficulties third generation scholars had in actually testing their hypotheses as a result of the ambiguity and complexity of said hypotheses (Lester and Goggin 1998; deLeon 1999; deLeon and deLeon 2002; O’Toole 2000; Smith and Larimer 2013). Scholars struggled to succinctly describe and define a general implementation framework as there appeared to be hundreds of variables that needed to be included from case studies (Smith and Larimer 2013). Two broad conclusions were drawn from this, that perhaps first generation implementation scholars were correct that a case study approach is the best course for further learning given the complexity of the topic (deLeon 1999), and a one size fits all framework may not be possible after all (deLeon and deLeon 2002; Smith and Larimer 2013). This led to implementation researchers developing contingency theories in order to acknowledge and adapt to the inherent complexities of the process (e.g., Ingram 1990; Matland 1995; Scheberle 1997) (deLeon and deLeon 2002). These contingency theories of 2x2 matrices helped match implementation problem conditions and

characteristics with the different implementation strategies that would improve the chances of implementation success (deLeon and deLeon 2002).

Despite these decades of scholarship, there was still a lack of operational understanding of implementation that would be useful to practitioners, a lack especially felt in the realm of natural resource management as the environmental/sustainability movement gained traction. Practitioners in this field and other applied sciences have continued to struggle to implement policies and sought guidance to improve implementation from the research community (O'Toole 2000). Implementation research has continued in disciplines outside of the traditional home of policy studies (Lester and Goggin 1998; Saetren 2005; Smith and Larimer 2013). Two of these areas are natural resource management and environmental policy. Even though laws have been passed by most countries on the planet to protect the environment, the environment has continued to deteriorate due to implementation failures (Le Quesne et al. 2010; Howes et al. 2017; UNEP 2019). Adding to the challenge, it is often necessary for practitioners in these areas to begin the implementation process while scientific uncertainty is still present regarding a policy. Consequently, scientists and practitioners working at the science-policy interface have had to develop their own implementation strategies for policies where scientific uncertainty is present in some capacity. Three such implementation strategies for dealing with scientific uncertainty that will be discussed further are the precautionary principle, adaptive management, and co-production of knowledge.

## **Precautionary Principle**

The precautionary principle is the least formulaic and structured of the three strategies, which can be both a blessing and a curse. The general idea of the strategy is that if there is a risk of serious or irreversible environmental damage, the existence of scientific uncertainty should not be used as a reason to postpone measures or actions that would prevent said damage (Bodansky 1991; Dovers and Handmer 1995; Gray and Bewers 1996; Santillo et al. 1998; Raffensperger and Tickner 1999), or as Pielke (2002) colloquially describes it, "better safe than sorry." This strategy is an attempt to avoid action paralysis because of scientific uncertainty and to be more proactive rather than responsive in handling environmental issues (Dovers and Handmer 1995; Gullet 1997; Balint et al. 2011). The precautionary principle represents a shift in who must provide proof that an action or policy is safe, instead of those against needing to provide proof of harm after the fact, those supporting a policy must prove lack of harm first (Dovers and Handmer 1995; Gullet 1997).

The principle was developed in the 1970s in what was then West Germany as part of a wider set of ideas that Germans called "ecological modernization" as the environmental impacts of the industrialized area became apparent (O'Riordan and Jordan 1995; Gray and Bewers 1996; Jordan and O'Riordan 1999). From West Germany the precautionary principle has spread throughout Europe and other western nations, though it has struggled to gain traction in the U.S. (Cameron and Abouchar 1991; Dovers and Handmer 1995; Raffensperger and Tickner 1999). It has been incorporated into multiple multinational and national laws, such as the Ministerial Declarations of the International Conference on the North Sea (MINDEC 1987; MINDEC 1990), the Montreal Protocol, the 1992 Rio Declaration on Environment and Development (RioDEC 1992), the 1992 Australian Intergovernmental Agreement on the Environment (Gullet 1997), the

Oslo and Paris Commissions (OSPAR 1992; OSPAR 1998), the 1995 United Nations Agreement on High Seas Fishing (UN 1995), and the Barcelona Convention (UNEP 1996). Moving from incorporation into law to policy implementation has proven to be more challenging than expected. Germany has used the precautionary principle as a guiding paradigm to respond to environmental problems like acid rain, pollution in the North Sea, and climate change during the 1980s (O'Riordan and Jordan 1995; Jordan and O'Riordan 1999). Australia has also worked to implement the principle, incorporating it domestically into law with the 1992 Australian Intergovernmental Agreement on the Environment (Gullet 1997). As Germany did, Australia was setting the precautionary principle to be the guiding principle for environmental legislation, but unlike with Germany, the principle did not trickle down into other domestic legislation (Gullet 1997). This has been a patten that has been repeated multiple times with the precautionary principle and as a result it has remained more of a guiding ideal than a concrete strategy with discrete steps for implementation (Jordan and O'Riordan 1999).

That lack has been one of the major critiques with the precautionary principle (Keeney and von Winterfeldt 2001; Starr 2003; Sunstein 2003; Balint et al. 2011). Another critique is that the precautionary principle has minimal value in dealing with real-world policy issues as it is poorly defined with an at times unscientific approach that does not specify what level of risk is acceptable (Bodansky 1991; Manson 2002; Pielke 2002; Sunstein 2003). There is a perception by some that public perception of harm or unsubstantiated suspicion instead of scientific evidence could be used under the guise of the principle to prevent unpopular policies from being enacted (Cameron and Abouchar 1991; Gray and Bewers 1996; Pielke 2002). In an effort to reduce environmental harm, critics argue that the precautionary principle results in a bias against

policies that would be more flexible and adaptive, which could result in the principle causing more harm than good (Balint et al. 2011). The precautionary principle is presented by advocates as challenging the hegemony of cost-benefit analyses that are typically used to assess policy choices as this type of analysis preferentially selects policies that will demonstrate short-term gains even if in the long-term the choice is harmful (O'Riordan and Jordan 1995; Jordan and O'Riordan 1999; Balint et al. 2011). Critics respond that while cost-benefit analysis may struggle to properly incorporate values into calculations and downplay long-term effects to discounting the future, the precautionary principle underestimates trade-offs and limits management flexibility on the ground (Sunstein 2003; Balint et al. 2011). Given that a precise definition of what the principle entails and what is required to implement it, the precautionary principle has become more of a political statement than a viable implementation strategy for dealing with uncertainty (O'Riordan and Jordan 1995; Dovers and Handmer 1995; Gray and Bewers 1996; Gullet 1997).

**Adaptive Management**

The second implementation strategy for dealing with uncertainty is adaptive management. Coming out of the arena of natural resources management, adaptive management is a technique that aims to reduce uncertainty and increase knowledge about the resource(s) being managed while acknowledging that management decisions must be made when full knowledge is not present. Formally introduced by C. S. Holling (1978) it built on concepts from business, experimental science, systems theory, and industrial ecology to create a framework that combines structured decision making and learning (see figure 2.1) to improve upon trial-and-

error decision-making (Allen et al. 2011; Williams 2011a). Carl Walters enhanced Hollings's work by further developing the concept to more explicitly include designed management experiments that would reduce uncertainty in decision-making (Walters 1986). Williams (2011a) details four of the most common sources of uncertainty present in natural resource systems: environmental variation, partial observability, partial controllability, and structural or process uncertainty, that adaptive management would theoretically help diminish (see Table 2.1). Of these sources, the most common one, environmental variation, is also the most discounted and/or unrecognized by decision makers (Williams 2011a). Ultimately, the main goal of adaptive management is to reduce uncertainty through learning and experimentation.

There are two variations of adaptive management: active and passive (Walters and Hilborn 1978; Walters and Holling 1990; Wilhere 2002; Gregory et al. 2006; McFadden et al. 2011; Williams 2011b). Active adaptive management is much more in line with the concept as it was originally conceived by Hollings in that uncertainty is reduced through deliberate experimentation. Under active adaptive management, Figure 2.2, several different management strategies and a control are implemented as structured experiments in parallel in order determine the optimum strategy (Wilhere 2002). The experimentation process allows for greater learning to occur than in passive adaptive management as cause-and effect relationships can be determined between the implemented strategies and observed changes in ecological conditions due to the use of a control (Wilhere 2002; Gregory et al. 2006). Learning is considered to be an expected product of active adaptive management so the objectives guiding decision making integrate both the expected uncertainty and the potential for learning (McFadden et al. 2011; Williams 2011b). A significant disadvantage to using the active variation though is that ultimately the necessary

experimentation is more expensive, complex, and potentially riskier socio-politically for resource managers to implement than the passive variation (Wilhere 2002; Gregory et al. 2006).

At first glance, passive adaptive management can appear very similar to a trial-and-error approach (Irwin and Wigley 1993; Parma et al. 1998). Under trial-and-error, managers implement a management plan and assume it is successful unless evidence to the contrary is found, which could be difficult if there is not a sufficient monitoring plan in place before, during, and after the plan is implemented (Wilhere 2002). Passive adaptive management also typically involves implementation of only one management plan, figure 2.3, but rigorous monitoring is a major component of the process so any perturbations to the ecosystem can be tracked and new information can be incorporated into models (Wilhere 2002). The focus is more on the effect of the management plan on resource(s) being managed, not as much on reducing uncertainty as with active adaptive management (Gregory et al. 2006; Williams 2011b). Learning can be incorporated into figure 2.4, but it is through the monitoring focus on likely changes in the status of the resource being managed (Gregory et al. 2006; Williams 2011b). Overall, passive adaptive management is focused more on the resource management problem, as compared to the active variation which is centered on the ecosystem altogether, including the resource being managed (McFadden et al. 2011). As mentioned earlier, an advantage of the passive variation is that it is usually simpler and cheaper overall to implement, but that comes at a cost: cause-and-effect relationships relating to management actions cannot be determined (Walters and Holling 1990; Wilhere 2002).

Over the last fifty years, adaptive management has been implemented for resource management in a multitude of complex environmental problems in the U.S, including the most

well-known example: restoration efforts in the Florida Everglades (Walters et al. 1992; Milon et al. 1997; Gunderson 1999; Gunderson 2001; Sklar et al. 2005; Gunderson and Light 2006; Light 2006; CERP Adaptive Management Steering Committee and Writing Team 2006; Guinto and Reed 2008; Zellmer and Gunderson 2008; LoSchiavo et al. 2013). Other broad problem areas where adaptive management has been utilized include river management (Quigley and Arbelbide 1997; Davidson and Geu 2001; Wissmar and Bisson 2003; Williams 2006; Gerlak 2008), regional forest management (Reeves et al. 2006; Rapp 2008), continental waterfowl harvest management (Johnson et al. 1993; Williams and Johnson 1995; Johnson and Williams 1999; Williams 2006; Nichols et al. 2007), habitat management (National Ecological Assessment Team 2006), and pest management in forested ecosystems (Shea et al. 2002), and commercial fisheries management (Hilborn 1992; Pinkerton 1999; Conover and Munch 2002; Walters 2007). Active adaptive management has been used in regional water management, with the aforementioned Everglades restoration work as well as the Glen Canyon Dam Adaptive Management Program (Zellmer and Gunderson 2008). Examples of passive adaptive management include the North American Waterfowl Management Plan (Johnson and Williams 1999; Nichols et al. 2007) and conservation efforts for red knots and horseshoe crabs (McGowan et al. 2009). While all of these examples have been U.S. focused, adaptive management has also been utilized for similar problems around the world (see Aldridge et al. 2004; Failing et al. 2004; Armitage et al. 2007).

Despite the many environmental management problems adaptive management has been applied to, the concept has proved to be a challenging one to move from theory to practice. There are few projects considered to be adaptive management successes (Lee 1999; Moir and Block 2001; Walters 2007; Allen and Gunderson 2011), such as with Glen Canyon Dam Adaptive

Management Plan (Gunderson and Light 2006; Zellmer and Gunderson 2008; Allen and Gunderson 2011). Other projects, such as in the Florida Everglades, are considered partial successes as some learning has occurred that greatly improved knowledge of the ecosystem and led to new management schemes but there has been no experimentation (Gunderson 1999; Gunderson and Light 2006; Allen and Gunderson 2011). On the whole, active adaptive management is considered to have failed in most of the large-scale problems where it has been applied (Allen and Gunderson 2011.) A key reason for this lack of implementation success is that the concept is often misapplied by practitioners, in part due to hazy understandings/ interpretations about what adaptive management actually is and what it entails, thus projects utilize adaptive management in name only (Gregory et al. 2006; Light and Gunderson 2006; Ruhl 2008; Allen et al. 2011; Allen and Gunderson 2011; Fontaine 2011). Adaptive management works best when used on environmental problems where uncertainty and controllability are high, Figure 2.4 (Gregory et al. 2006; Allen et al. 2011; Allen and Gunderson 2011). Controllability refers to logistical, political, and financial ability of a manager to affect resources through management. Environmental problems are situated in broader social and political contexts that can greatly affect, or even halt altogether, management action (Allen and Gunderson 2011).

Adaptive management is a poor tool for problems of entangled complexity involving high external influences, long time spans, high structural uncertainty due to unknowns in the relationships between ecological variables involved, and poorly designed/constructed monitoring plans for assessment (Gregory et al. 2006; Allen and Gunderson 2011). Many practitioners want to implement adaptive management because of the perception that it is "learning by doing," but they fail to account for the entirety of the framework, especially the financial costs for

appropriate monitoring for decision-making and learning (Gregory et al. 2006). Assessment is a key component of adaptive management, thus design and funding of the monitoring program should be incorporated into the management strategy from the beginning of the process (Wilhere 2002). After surveying the adaptive management implementation literature, two researchers, Craig Allen and Lance Gunderson (2011), developed a list of nine characteristic attributes that are typically present in failed adaptive management projects (Table 2.2). Each of these attributes can result in failure of the adaptive management process; often multiple are present in a program or project. Indicators that an adaptive management process is failing due to these attributes can range from obvious to subtle, from stakeholders claiming they have already been doing adaptive management to the ecosystem or resource continuing to degrade while the process is in a repetitive discussion cycle (Allen and Gunderson 2011). Indeed, adaptive management can and has been used to as a tool of last resort by decision makers dealing with wicked social-ecological problems to help maintain the status quo (Allen and Gunderson 2011).

Another impediment to the management experimentation of adaptive management is institutional rigidity and the letter of environmental law (Garmestani et al. 2009). The uncertainty and unpredictability of many environmental problems does not combine well with the certainty required in law (Allen et al. 2011). The current legal administrative framework is not equipped to appropriately handle the "surprise" element characteristic of the dynamic environmental systems where adaptive management is deployed as it is built on the concept of stationarity (Ruhl 2008; Ruhl and Fischman 2010). This results in U.S. administrative agencies, despite claiming to, being unable to implement adaptive management plans for environmental projects, instead deploying a sort of "adaptive management-lite" that allows for very limited experimentation

(Ruhl and Fischman 2010). Current funding paradigms also hamper adaptive management implementation as they favor reactive approaches, not proactive approaches (Allen et al. 2011). Many of the implementation problems are more institutionally driven than technical as there are tensions between how institutions have previously handled learning and decision making and the more flexible, experimental approach of adaptive management where uncertainty is embraced and other perspectives are incorporated through engagement with stakeholders (Gunderson 1999; Stankey et al. 2005). Many in the scientific community still believe adaptive management holds promise when it is applied to the appropriate problems, those where scientific uncertainty exists, there are finite competing hypotheses concerning the optimal management strategy that are testable, commensurate resources are available to allow for experimentation, and strong enough leadership present to keep the project on track (Allen and Gunderson 2011).

**Co-Production of Knowledge**

The third implementation strategy, co-production of knowledge, has been developed more recently than the previous techniques and demonstrates promise in helping decision makers effectively handle scientific uncertainty through increasing the relevance and usability of science for society (Lemos and Morehouse 2005; Meadow et al. 2015; Wall et al. 2017). Co-production of knowledge is built on the concept of iterativity as Lemos and Morehouse (2005) define it, meaning that those at the science-policy interface need to build internal and external networks that can sustain continuing flows of information and active participation between scientists and decision makers from the public, non-governmental, and private sectors (Figure 2.5). In terms of action, Figure 2.5 represents building long-lasting relationships between scientists and

stakeholders/decision makers that allow for two way communication flows between the groups and maintaining a focus on the production of usable science (Lemos and Morehouse 2005; National Research Council 2009; Dilling and Lemos 2011). Usable science is defined as scientific information that meets expressed constituent needs, is understandable to users, is available at the times and places it is needed, and is accessible through the media sources consumed by the user community (Lemos and Morehouse 2005). Interest in this technique has been growing rapidly in recent years in the areas of climate change adaptation and environmental management and governance (Lemos and Morehouse 2005; Visbeck 2008; Asrar et al. 2013; Ziervogel et al. 2016; Wamsler 2017).

Co-production of knowledge has been implemented successfully in a handful of the case studies in environmental management (e.g., Kirono et al. 2014; Cvitanovic et al. 2016; Campbell et al. 2016; Foley et al. 2017), agricultural management (e.g., Castellanos et al. 2013; Podesta et al. 2013; Akpo et al. 2015; Kraaijvanger et al. 2016), and fisheries (e.g., Young et al. 2016). As a result of the growing impacts from climate change, there is currently more of a demand for usable climate science information than what has been produced by the scientific community thus far (Dilling & Lemos 2011; Moss et al. 2013; Lemos et al. 2014), leading some to turn to co-production of knowledge to help meet this demand. The concept is still transitioning from theory to practice, resulting in those scientists seeking to replicate the successes of the above studies understandably struggling to turn figure 2.5 into an actionable set of steps to reproduce (Meadow et al. 2015). One example of how to operationalize the concept is Djenontin and Meadow's (2018) model, Figure 2.6, but it still leaves gaps in how to implement co-production. Collaboration in co-production of knowledge goes beyond pro-forma interactions between

researchers and decision makers; superficial interactions are unlikely to result in co-production (Pregernig 2006). Collaborative activities must be planned and incorporated into the research process from the very beginning (Lemos et al. 2012; Meadow et al. 2015), including stakeholder and decision maker involvement in the formulation of research questions (Wall et al. 2017).

Co-production of knowledge requires different support structures as compared to traditional research funding mechanisms (Klenk et al. 2015; Lemos et al. 2018; Arnott et al. 2020). Funders are increasingly emphasizing the importance of the usability of funded research and thus can play a meaningful role in supporting the implementation of co-production of knowledge through incentivizing collaboration (Arnott et al. 2020). Even with financial support, there are still significant barriers to implementation. Co-production of knowledge requires an intensive investment of time and other resources by participants which some may not have available, especially if there is a scale mis-match between the scientists and the stakeholders (Kirchhoff et al. 2013; Lemos et al. 2014). Low or unrealistic expectations and fatigue with the process from non-researchers can make it more difficult to form and maintain the meaningful relationships needed for collaboration to succeed (Briley et al. 2015; Newton and Elliot 2016). It also has not been shown how this strategy can be implemented at scale given the dependence on face-to-face interactions and trusted relationships (Arnott et al. 2020). Co-production of knowledge is a technique that shows much promise in creating usable scientific information for decision makers and potentially minimizing uncertainty, but is not clear yet if the operationalization of the concept can fulfill that promise.

**Figures and Tables**

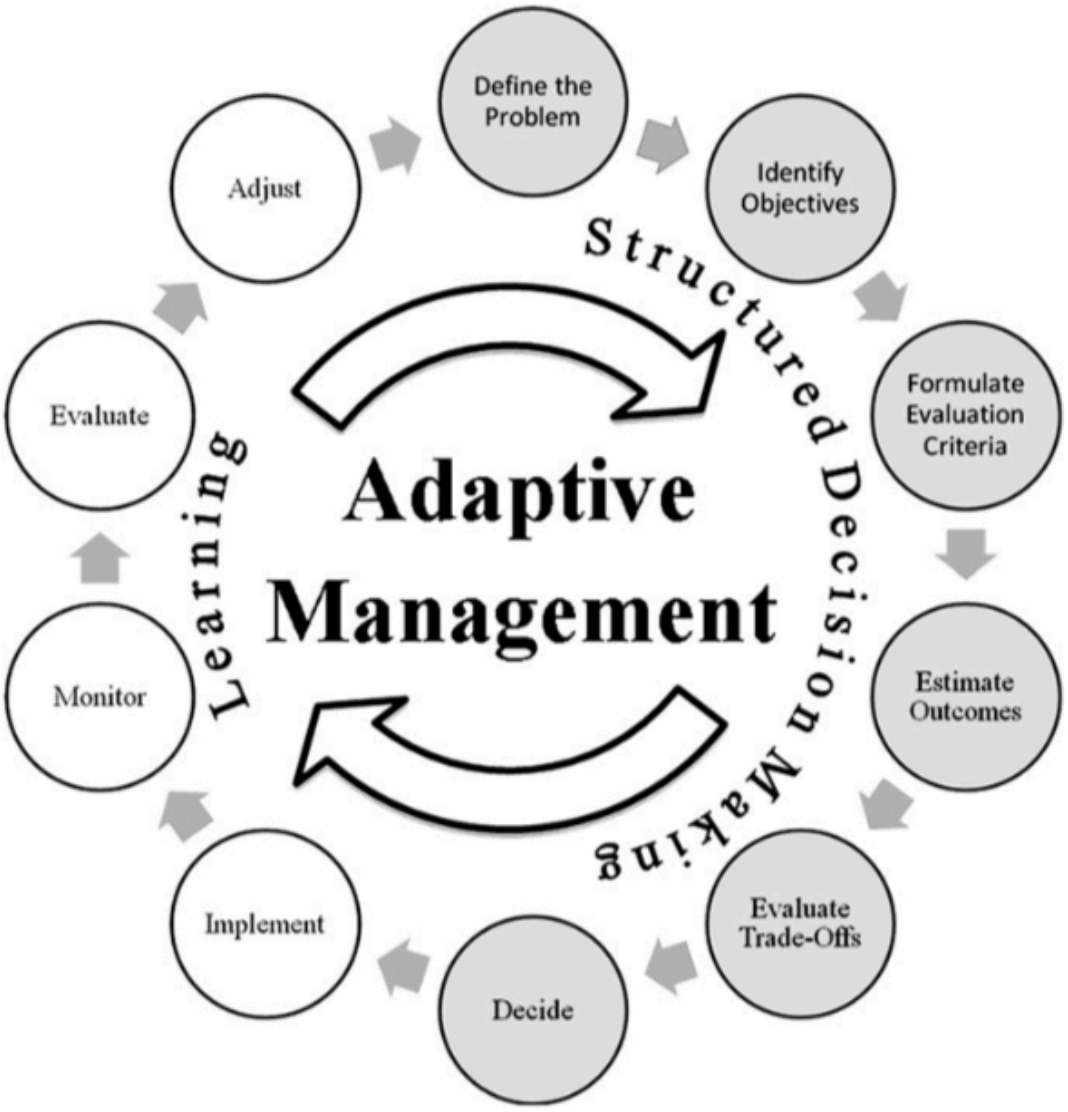


Figure 2.1: Adaptive management framework (from Allen et al. 2011). The gray circles represent the steps of the framework that are structured decision making and the white circles represent those steps that encompass learning.

| Source of Uncertainty | Definition |
|---|---|
| Environmental Variation | The most common source of uncertainty and is typically uncontrollable. This uncertainty often has a major impact on natural resource systems |
| Partial Observability | Uncertainty about the resource itself due to incomplete knowledge |
| Partial Controllability | Difference between the actions decided by decision makers and the actions that are actually implemented due to misunderstanding or misrepresentation of the decision makers decided actions |
| Structural or Process Uncertainty | The disagreement or lack of understanding about the structure of the biological and ecological relationships that makeup resource dynamics |

Table 2.1: Four common source of uncertainty that can affect the management of natural resource systems (Williams 2011a). Adaptive management can help ameliorate these uncertainties and allow for management to occur while these uncertainties are still present.

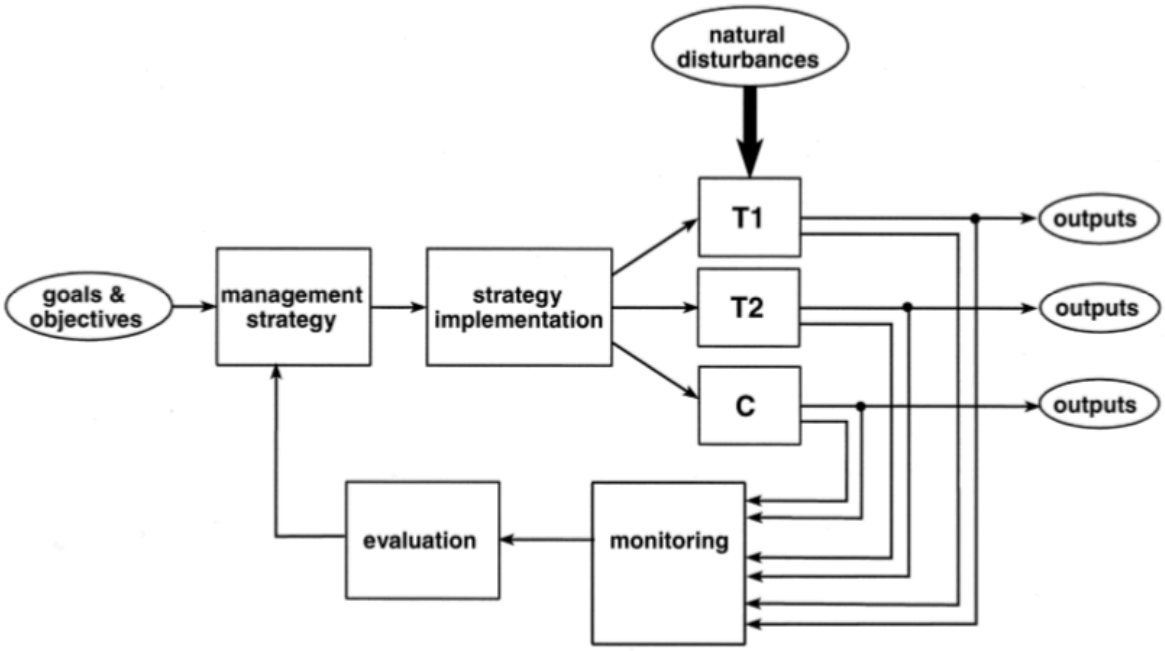


Figure 2.2: Active adaptive management block diagram (from Wilhere 2002). The different resource management strategies are listed as T1 and T2 with C being the control.

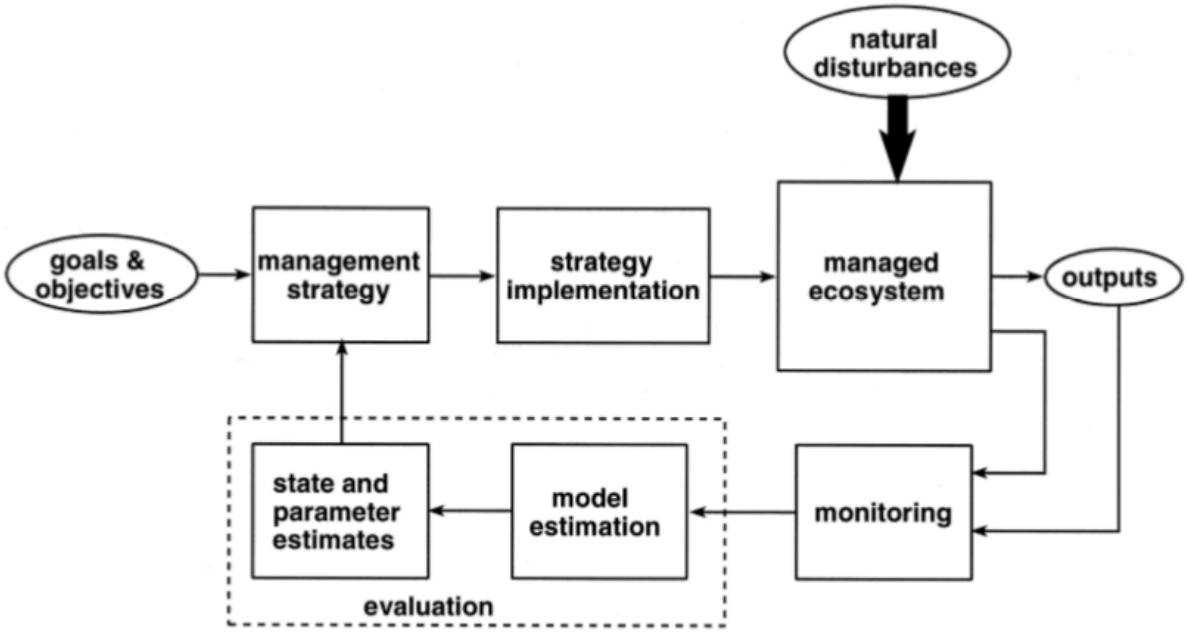


Figure 2.3: Passive adaptive management block diagram (from Wilhere 2002, modified from Walters and Hilborn 1978). Unlike with active adaptive management, only one policy is implemented at a time, there is no parallel experimentation.

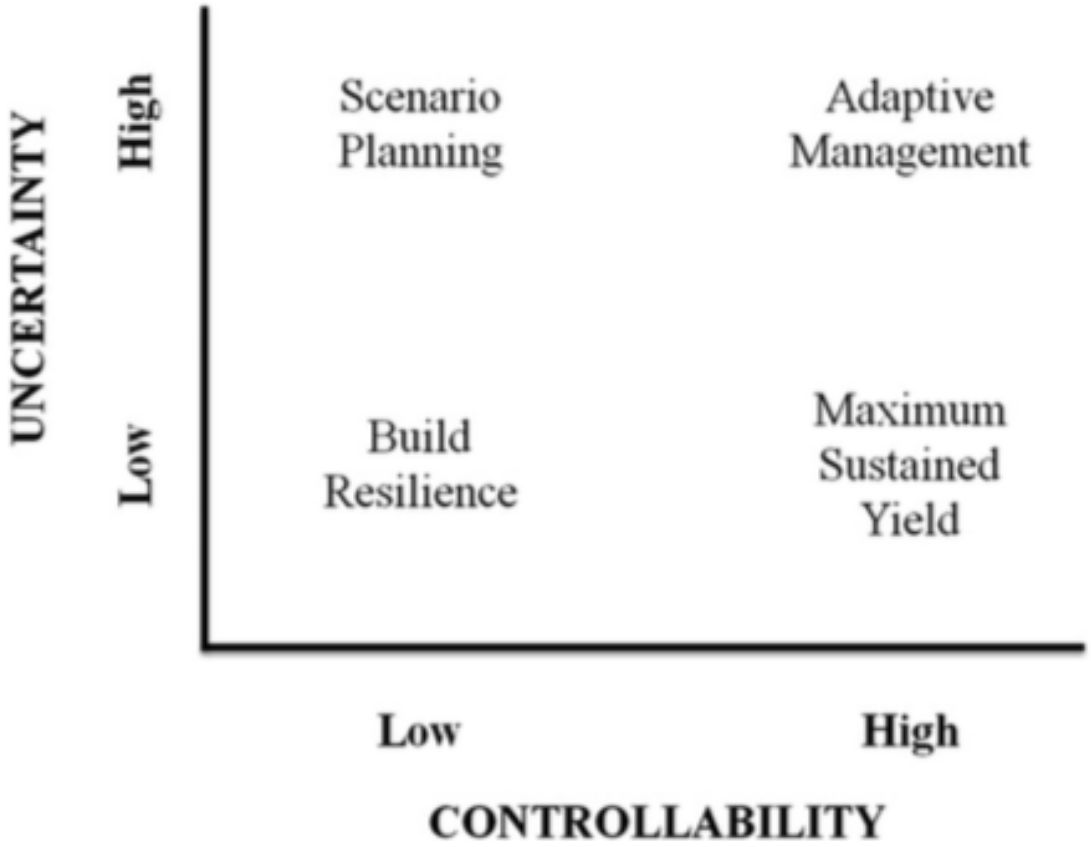


Figure 2.4: Adapted from Peterson et al. (2003), based on the level of uncertainty and controllability what management strategy would be the best for a particular project (Allen et al. 2011; Allan and Gunderson 2011). Scenario planning is a systemic management strategy for determining multiple possible outcomes incorporating the key uncertainties of the system instead focusing on accurately predicting a single outcome. It is similar to adaptive management and a better choice when management experiments are not a realistic option (Peterson et al. 2003).

| Adaptive Management Project Characteristic | Brief Description |
|---|---|
| Lack of stakeholder agreement/engagement | Stakeholders rejecting results that differ from their expectations, caused by either a lack of engagement with stakeholders early on in the process or a failure to include certain stakeholders in the process all together. |
| Experiments are difficult | Experiments are challenging to design and complete due to characteristics of the ecosystem to be managed, including being very large and slow to respond to interventions. These spatial and temporal characteristics also make replication difficult. Additionally, there are typically multiple jurisdictions that operate across the ecosystem are equivalently large and complex. |
| Surprises are surpressed | Surprises should be expected when dealing with complex socio-ecological systems. Humans are not particularly good at dealing with uncertainty and surprises, and may try to suppress any surprise that occurs during the process as an externality. |
| Prescriptions are followed | New knowledge is not incorporated into the process, the adaptive management plan is implemented exactly how it was formulated at the beginning of the process. This can occur when adaptive management plans are too complex in their internal organization or too complex and fragile in their stakeholder network. |
| Action procrastination: learning and discussion remain the only ingredients | Calls for more science due to the level of uncertainty stall the actual implementation of an adaptive management plan. The process is allowed to dominate at the expense of action and implementation of new learning. |

| Adaptive Management Project Characteristic | Brief Description |
|---|---|
| Learning is not used to modify policy or management | Adaptive management is used by those in power as a way to placate stakeholders while continuing business as usual. There is no reduction of uncertainty over time through management actions. |
| Avoiding hard truths: decision makers are risk averse | Small experiments are conducted in perpetuity as way to bypass engaging with underlying management issues that are controversial. This is a way to avoid dealing with hard truths about the political and/or economic viability of any or all management options. |
| Process lacks leadership and direction | No stakeholder, or stakeholder group, should have more influence over the process than any other, stakeholders should not be the decision makers in the adaptive management process. Strong leadership is needed for success, along with a skilled facilitator. |
| Focus on planning, not action | Large adaptive management projects can end up stuck in the planning loop due to multiple reasons, including a desire for perfection, a faulty or inaccurate understanding about adaptive management or due to the funding or sponsoring agency deciding to keep the process in a continuous planning loop. |

Table 2.2: The nine characteristics commonly found in environmental management projects where adaptive management fails (Allen and Gunderson 2011).

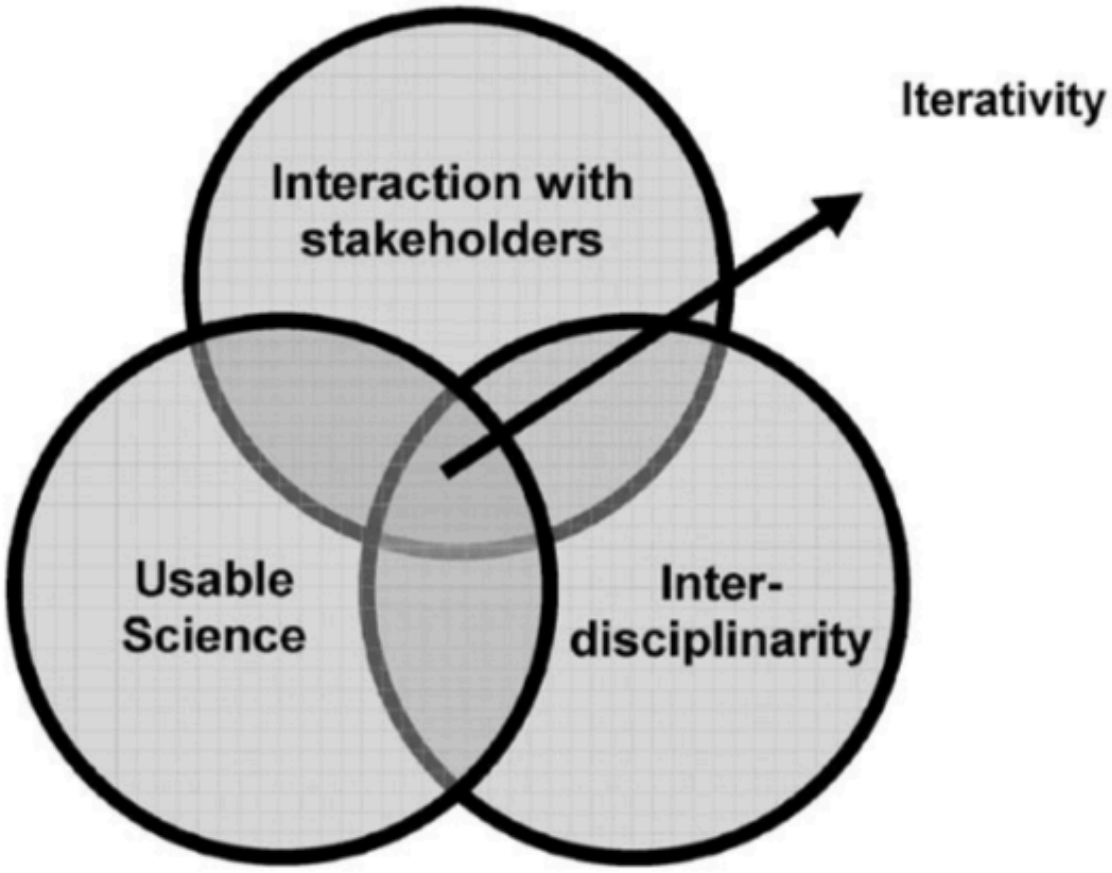


Figure 2.5: Conceptual model of co-production of knowledge, demonstrating how the three core concepts, interaction with stakeholders, usable science, and interdisciplinarity must continuously interact with each other (Lemos and Morehouse 2005).

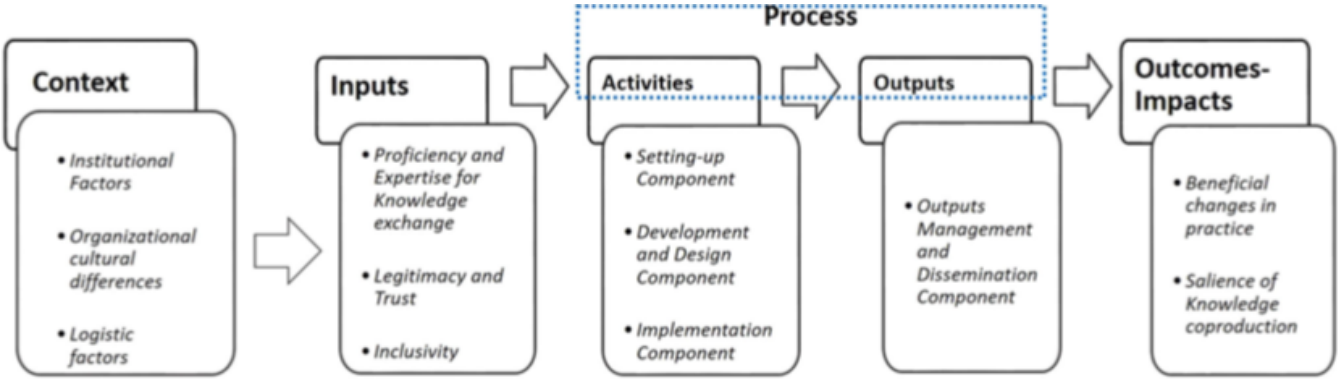


Figure 2.6: A preliminary model that attempts to operationalize co-production of knowledge through the multiple criteria were present in nine case studies (Djenontin and Meadow 2018).

# Chapter 3: A Recent History of Coastal Erosion and Flooding in Louisiana

The entirety of southern Louisiana owes its existence to sediment deposited by the Mississippi River (Van Heerden and Bryan 2006). Over the past five to seven millennia the annual spring floods of the river have laid down many tons of sediment that today form the deltaic plain that encompasses the state of Louisiana (Van Heerden and Bryan 2006; Campanella 2008). As the river meandered across the entirety of what is now the coastline of Louisiana, it deposited alluvial sediment unevenly throughout the region, creating land with slight rises in elevation above sea-level that were home to later human settlement (Van Heerden and Bryan 2006). The Mississippi River has had several deltas over the past seven and a half thousand years, with the Maringouin/Salé-Cypremort Delta Complex (7.5-5 thousand years before present (BP)) being the oldest (Figure 3.1) and the Plaquemines-Balize Delta (1.3 thousand years BP to present) and Atchafalaya-Wax Lake Delta (50 years BP to present) Complexes being the most recent (Coleman 1988; Campanella 2008; Morris 2012; Alexander et al. 2012). As a result of this land creation process, the city of New Orleans is located on land that is composed of silty, sandy soils, high in organic content, that are poorly drained and very unstable compared to the solid North American lithosphere that the majority of the continent is built on (Campanella 2008). These unstable, alluvial soils are also extremely prone to subsidence unless replenished by flooding from the Mississippi (Campanella 2008), further exacerbating the flooding risks the city faces.

## The Creation of the City of New Orleans

Given the flood-prone topography of southeastern Louisiana, from a purely hazard vulnerability lens the choice to locate a major colonial settlement on the banks of the Mississippi

River would seem to be an unwise decision. The French though were more concerned with controlling the mouth of the Mississippi River as it would provide a strategic advantage over other European Colonial powers through providing the French with reliable access to both the interior of the North American continent for commercial development and the Atlantic Ocean by way of the Gulf of Mexico (Campanella 2008; Morris 2012; Colten 2018). Jean-Baptist Le Moyne, Sieur de Bienville, the younger brother of French explorer Pierre Le Moyne, Sieur d'Iberville (Campanella 2008), was charged with siting a settlement that would allow for a deep water port on the river, which was needed for both riverine and coastal commerce, as well as granting the French a strategic military position at the mouth of the Mississippi River basin, preventing English or Spanish encroachment into the continental interior (Campanella 2008). Bienville selected a location on a sliver of high ground on the eastern bank of the Mississippi for this settlement in 1718, which today is the French Quarter (Campanella 2008; Colten 2009). This location was close to a portage that local Native Americans had been using between the river and the lake that would later be named Pontchartrain (Kelman 2006, pg. 4; Colten 2006, pg. 2; McQuaid and Schleifstein 2006; Campanella 2008), allowing French colonists control of two access routes to the Gulf of Mexico and thus control of much of the interior of the North American continent.

Almost as soon as the settlement was platted the city began experiencing flooding from both the river and hurricane storm surge. The Mississippi partially flooded the city in spring of 1719 (Campanella 2008) and a pair of strong hurricanes hit the city in 1722 and 1723, causing widespread flooding and destroying all the structures in the nascent city (McQuaid and Schleifstein 2006; Campanella 2008; Colten 2009; Keim and Muller 2009). Immediately the

construction of the first earthen levees along the river was begun by the Company of Indies in an effort to protect the city from future flooding (Colten 2005). These levees were a public works project designed to protect the dense urban core of the developing city (Colten 2005). Throughout the early history of the city, the Mississippi flooded all or portions of New Orleans about every 10 to 20 years (Campanella 2008). After each flood there was a push to build more levees along both banks of the river in order to control the river and keep it in its channel (Campanella 2008). Figure 3.2 shows a cross-section of the current Mississippi River levees to demonstrate how the levees were built to an increased grade (height) and section (width) to accommodate this increased flood risk.

The city has not experienced direct flooding from the Mississippi since 1862 thanks to a river levee system stretching hundreds of miles upstream (see Figure 3.3) (Colten 2006), but the potential threat the river poses has only increased since then as the levees have prevented the annual cycle of flooding that helped to replenish the delta soils and prevent subsidence (Campanella 2008; Day et al. 2014). This cycle of flooding allows for the dissolved sediment contained within the Mississippi River to spread out across its flood plain, depositing coarser sediments closer to the regular banks of the river, thus building them higher into natural levees, while finer grains of sediment are carried farther out to settle on naturally subsiding coastal wetlands and extend the deltaic plain. With the system of levees shown in Figure 3.3, the sediment the river carries stays within the engineered channel of the river, depositing along the river stream bed and slowly increasing the elevation of the river itself, leading to higher flood heights that necessitate higher levees. This disconnection of the river from its surrounding deltaic

plain is one of the factors causing the coastline to wash away in Louisiana, but not the sole cause (Day et al. 2014).

Hurricanes from the Gulf of Mexico have proven to be the bigger inundation hazard in the last century as the warm waters of the Gulf have a tendency to fuel large hurricanes with punishing storm surges (Keim et al. 2007). The return period for tropical cyclones along the north-central Gulf Coast are approximately 3-4 year with the return period for major hurricanes, category 3 or higher on the Saffir-Simpson scale, being about 26 years (Keim et al. 2007). Hurricanes have been a constant specter looming over the city every June through November and could strike with little warning prior to WWII. As with flooding caused by the river, after every flood due to storm surge there would be a push by residents to build more public levees or increase the height of existing levees in an attempt to further strengthen the flood protection of the city (see Figure 3.2) (Colten 2005; Colten 2006). Though there have been many flood events in the city's history; three, the Great Mississippi Flood of 1927, Hurricane Betsy of 1965, and Hurricane Katrina of 2005, resulted in major changes to flood control policies throughout the system. During the same period of time, the coast of Louisiana was also losing acres of wetlands that had been a valuable ecological component of storm surge reduction through their ability to absorb storm surge, reducing the height of the surge by roughly one foot for every 2.7 linear miles of wetlands (Brinkley 2006, pg. 13; Campanella 2008, pg. 324). That reduction can vary greatly based on the bathymetry of the coastline, coastal structures, and wetland characteristics as well as attributes of the hurricanes such as the size of the storm, the track, and the intensity at landfall (Wamsley et al. 2010). Louisiana contains within its borders approximately 40% of the total wetlands of the United States but also roughly 80% of the country's wetland losses

(Williams 1995). In total, Louisiana is estimated to have lost over a million acres of coastal wetlands in the last 60 years (Gotham 2016) (Figure 3.4).

**Significant Flooding Events of the 20th Century**

The city and surrounding environs have flooded multiple times since the Mississippi River created the land, but four flooding events, two from the twentieth century and two from the twenty-first, have inadvertently contributed to the current coastal erosion problem. The Mississippi River Flood of 1927, Hurricane Betsy in 1965, and Hurricanes Katrina and Rita in 2005 have all played a part in either demonstrating the extent and consequences of the problem, the case in the latter two events, or through inspiring policies that helped create the erosion problem, as was in case with first two events.

The Great Mississippi River Flood of 1927 did not flood the city of New Orleans itself, but it caused widespread devastation upriver as it moved slowly downstream. The flood was caused by a period of exceptionally heavy rainfall from mid-1926 through early 1927 throughout the Mississippi, Missouri, and Ohio River Valleys that caused the rivers to swell well above capacity (Barry 1997). As the rain continued to fall, river gauges recorded water heights along the Mississippi River almost 10 feet higher in some places than had ever been recorded before (Barry 1997). The city was saved from potentially catastrophic flooding after several major levee breaks upstream channeled the flood waters into the Atchafalaya Basin and away from the city (Barry 1997). In an extremely controversial move, the urban elite of the city convinced President Calvin Coolidge to authorize the destruction of a levee downstream of the city at Caernarvon, Louisiana, in St. Bernard Parish, a poorer, more rural community (Colten 2006; McQuaid and

Schleifstein 2006), in effort to take pressure off of the New Orleans river levees, an act that proved to be unnecessary due to the levee breaches up stream (Barry 1997; McQuaid and Schleifstein 2006). This act was justified by the urban elite due to the levees being a public good that had been designed and historically used to protect the City and not the agricultural hinterlands (Colten 2005).

Leading up to 1927, the Army Corps of Engineers had operated under a "levees only" policy in designing and building flood protection along the Mississippi River. The only flood control structures authorized were levees under the belief that if the river could be kept within its banks it would flow faster, thus carving out a deeper channel which would prevent future flood events (Barry 1997; Reuss 1998; McQuaid and Schleifstein 2006). The 1927 flood dramatically demonstrated the falsity of this belief and led to the development of the current "levees and outlets" policy (Barry 1997; Reuss 1998; Campanella 2008). The adoption of this policy, as well as the passing of the Flood Control Act of 1928, authorized the Corps to rebuild the public levees damaged in the flood and to design spillways, such as the Bonnet Carré Spillway in St. Charles Parish and the Morganza Spillway in Point Coupee Parish, that when opened during high river water levels can act as safety valves for the entire levee system (Campanella 2008). This policy also marks the beginning of increasing involvement of the Corps in flood protection in the lower Mississippi River Valley (Colten 2005; Campanella 2008).

Hurricane Betsy in 1965 provided an eerie foreshadowing of the destruction Hurricane Katrina would cause forty years later (McQuaid and Schleifstein 2006; Van Heerden 2007; Campanella 2008; Colten 2009). Betsy made landfall on the Louisiana coast just south of New Orleans on September 9, 1965, as a strong Category 3/weak Category 4 storm (Van Heerden

2007; Keim and Muller 2009; Colten 2009). It tracked south of New Orleans, following along the west bank of the Mississippi River and devastated the city and its surrounding environs. It caused disastrous flooding in New Orleans East, the Lower Ninth Ward, and parts of St. Bernard Parish with water depths reaching about up to ten feet (McQuaid and Schleifstein 2006; Colten 2009). Seventy-five people died as a result of Betsy and more than 160,000 homes were flooded (Van Heerden 2007; Campanella 2008; Keim and Muller 2009). The damage from the hurricane led to President Lyndon B. Johnson and Congress to mandate that the city be protected by the Army Corps of Engineers from the "most severe combination of meteorological conditions reasonably expected" and the creation of the Greater New Orleans Hurricane Protection System, a series of levees sixteen feet high in and around the city to protect it from flood waters from a variety of sources (McQuaid and Schleifstein 2006; Van Heerden 2007; Keim and Muller 2009; Colten 2009). This was in addition to the levees that already existed upstream along the Mississippi River to control and channel the waters of the river that the Corps already managed (Van Heerden 2007; Colten 2009).

Leading up to Hurricane Katrina in 2005, few residents of the city realized that the levee system that had been mandated forty years prior was still not finished (Van Heerden 2007). Funding shortfalls and budget overruns had ballooned the costs of building the requested levee system as designed (McQuaid and Schleifstein 2006; Colten 2009). Subsidence rates and the weak soil strengths surrounding the New Orleans metropolitan area were also not factored into the Corps planned levee system, resulting in many of the levees that had been constructed being lower and less stable than they were supposed to be, leading citizens to believe they were more protected than they actually were (Van Heerden and Bryan 2006; Van Heerden 2007). This

combined with the low ratio of hurricane strikes to hurricane threats lulled residents into a sense of complacency about the level of risk they were exposed to (Keim and Muller 2009). There was widespread belief that most storms would curve away from the city at the last minute and make landfall elsewhere along the coast, and if a rare storm happened to make landfall it would be well within the scope of what the levee system was designed to withstand (Keim and Muller 2009). This public complacency helped foster the dangerously high levels of unpreparedness that permeated all levels of city, state, and federal government and helped contribute to the massive disaster that Hurricane Katrina became (Cooper and Block 2006; McQuaid and Schleifstein 2006).

Hurricane Katrina made its second landfall near Buras, Louisiana, as a strong Category 3 hurricane on the morning of August 29, 2005. At the time of landfall, sustained winds were 125 mph and it produced 8-10 inches of rain in the eastern part of the state along with a storm surge of 12-14 feet (Brinkley 2006; Johnson 2006). It made its final landfall near the mouth of the Pearl River in Mississippi a few hours later, still as a Category 3 storm. Conditions along the Mississippi Gulf Coast were catastrophically bad as the storm produced a storm surge in excess of 25 feet along the coastline that moved inland 6 miles in many areas and as much as 12 miles in others (Brinkley 2006; Johnson 2006; Knabb, Rhome, and Brown 2011).

The city of New Orleans experienced Katrina as a Category 1 hurricane due to the city's location to the west of landfall. Despite these relatively mild storm conditions as compared to Mississippi, New Orleans experienced multiple catastrophic levee failures that led to 80% of the city being flooded with water levels being anywhere from a 1-2 feet to over 10 feet in some of the lowest lying parts of the city (Johnson 2006; Knabb, Rhome, and Brown 2011; McQuaid and

Schleifstein 2006). Breaches along the 17th St. Canal, the London Avenue Canal and the Industrial Canal caused much of this flooding (Johnson 2006; McQuaid and Schleifstein 2006). Many of the deaths that occurred in Louisiana were near these levee breaches as the water flooded in immediately after the breach, too quickly for people to evacuate. Due to the poor placement of the pumping stations in the interior of the city as well as poor placement of some of the navigation canals, most notably the Mississippi River Gulf Outlet (MRGO), many of the canals throughout the region acted as funnels to bring even more storm surge than what was expected into the city, leading to overtopping and outright failures of the levees, which overwhelmed the pumps and resulted in their failure to pump water out of the city (Horne 2006; McQuaid and Schleifstein 2006; van Heerdan 2007).

Just a few weeks after Katrina made landfall, Hurricane Rita roared ashore near the Texas/Louisiana border, slightly east of the Sabine Pass, as a Category 3 storm (Keim and Muller 2009; Knabb, Brown, and Rhome 2011; Thibodeaux 2012). Like Katrina, Rita was also a Category 5 storm, only weakening in the forty-eight hours before landfall on September 24th (Keim and Muller 2009; Knabb, Brown, and Rhome 2011). The southwestern portion of Louisiana is acutely vulnerable to storm surge due to the low elevation of the land and wetlands that make up the coastline there (Knabb, Brown, and Rhome; Thibodeaux 2012). Rita brought at least 15 feet of storm surge ashore, causing tremendous ecological damage to the protective wetlands as well as the communities and parishes along the coast (Thibodeaux 2012). Since the storm did not make landfall near New Orleans, and due to the much lower fatality count, Rita received little media attention once it made landfall though it had a large impact on the already reeling state of Louisiana (Thibodeaux 2012).

The entire two hundred and fifty mile stretch of Louisiana coastline nicknamed Acadiana (see Figure 3.5) was affected by Rita with many of the coastal parishes being almost if not completely submerged by the accompanying storm surge. Many of the towns and communities in the coastal southwestern section of the state were completely destroyed, including the towns of Cameron, Holly Beach, Grand Cheniere, and Creole in Cameron Parish alone (Knabb, Brown, and Rhome 2011). Flooding extended significantly inland as well with severe damage reported in the Lake Charles and Calcasieu Lake areas (Knabb, Brown, and Rhome 2011; Thibodeaux 2012). Some areas of New Orleans, particularly the Ninth Ward, were flooded for a second time due to the storm surge from Rita as the emergency patches installed on the levee system did not completely hold, requiring the city to be pumped dry for a second time (McQuaid and Schleifstein 2006; Horne 2006; Keim and Muller 2009; Knabb, Brown, and Rhome 2011).

**The Interconnected Causes of Land Loss**

As mentioned earlier, the levees containing the Mississippi River within its current banks are only one component of several interconnecting issues causing the coastline to crumble into the Gulf of Mexico. Human activity both upstream and in the delta itself have contributed to the current land-loss crisis in Louisiana. The Mississippi River carries a much reduced sediment load as compared to before European settlement of the river valley due to the practice of building upstream dams on the river's tributaries for flood control and irrigation purposes. In the delta proper, oil and gas exploration have resulted in a tattered network of canals that were dug into the coastal wetlands themselves, allowing for saltwater intrusion and disruption of the normal deltaic hydrology, leading to even greater land loss. Additionally, climate change is dramatically

illuminating the cumulative effects of all of these contributors to coastal erosion in the marked increase of flooding events in coastal communities in recent years.

A major driver of the reduced sediment load of the Mississippi River is the system of upstream dams that were put in place on the both the river itself and its tributaries, such as the Missouri, the Ohio, and the Red Rivers, as a result of the 1928 Flood Control Act, enacted after the 1927 flood (Barry 1997; Reuss 1998; O'Neill 2006). After this flood and until the rise of environmentalism, the Army Corps of Engineers went on a protracted building spree of dams on the major rivers of the United States as a way of providing flood control (Reuss 1998; O'Neill 2006). As a result of the extensive damming of the Mississippi River watershed, the Mississippi River as it runs through Louisiana carries roughly one half the sediment load that it did at the beginning of the twentieth century (Kesel 2003; Allison and Meselhe 2010; Allison et al. 2012; Bentley, Willson, and Freeman 2012). This reduction in sediment load reduces the capability of the river to build new land in the areas where it is not restricted by said dams to its current channel, a constraint that would decrease the effectiveness of proposed sediment diversions (Thorne et al. 2008; Blum and Roberts 2009).

Louisiana has a long history with oil and gas exploration and development, tracing back to the beginning of the industry in the United States. Oil was first discovered in Louisiana on Jules Clement's property in southwestern Louisiana on September 21, 1901, shortly after the more famous oil discovery at Spindletop in southeastern Texas (McQuaid and Schleifstein 2006; Zebrowski and Leach 2014; Theriot 2014; Houck 2015). Standard Oil built Louisiana's first of many refineries near Baton Rouge in 1909 and the oil boom truly began for the state (McQuaid and Schleifstein 2006; Houck 2015). Oilmen from Texas and around the country started moving

to Louisiana in the 1920s and 1930s, transforming rural coastal communities as well as the local landscape with canals, pipelines, and drilling barges (McQuaid and Schleifstein 2006; Theriot 2014). The canals in particular have been detrimental to coastal wetlands as they allow for salt water intrusion from the Gulf of Mexico into freshwater marshes, leading to plant die-off and open water to appear (Theriot 2014; Houck 2015; Gotham 2016). An example of this type of damage can be seen in the wetlands near Delacroix, Louisiana (Figure 3.6). Figures 3.7 through 3.11 are a time series of aerial photographs demonstrating the damage just a few canals caused to wetlands near Delacroix. Adding to the damage, many of the canals have not been kept in good repair, further exacerbating the ecological damage they cause (Gotham 2016).

The influx of money from the oil boom led to widespread corruption at the state and local levels that has had long lasting effects on the psychology of the citizens of the state. Louisiana governor Huey Long (1893-1935) was among the first to develop a mutually beneficial, and corrupt, relationship with oil companies operating in the state (Parent 2004; McQuaid and Schleifstein 2006; Zebrowski and Leach 2014; Houck 2015). In return for the oil and gas industry paying comparatively high state taxes they would be allowed to operate with little oversight in Louisiana (Houck 2015). This led to oil and gas interests dominating Louisiana politics as the taxes from this industry basically funded the state government and paid for much needed social programs throughout the state (Parent 2004; Houck 2015). Consequently, the citizens who benefited from these programs kept electing to power politicians who would continue the "agreement". Several generations of Louisianians have come of age under this unofficial "agreement," which has not only molded the politics and economy of the state (Parent 2004; Theriot 2014) but has also restricted the mindset of many of its citizens in regard to the

effects and consequences of the oil and gas exploration and drilling on the environment (Robertson 2013; Houck 2015).

The global mean sea level has risen between 4 to 8 inches over the past century, with the rate of sea level rise accelerating in the last few decades (Church and White 2006; Cazenave and Level 2010). This is particularly detrimental for coastal Louisiana as wetlands are negatively responsive to sea level rise if they cannot accrete material vertically at a rate comparable or greater to the local rate of sea level rise (FitzGerald et al. 2008). Higher sea levels will also increase saltwater intrusion into freshwater marshes (Terando et al. 2018). Exacerbating this problem, the Louisiana coastline is composed of compacting sediments so the effects of relative sea level rise are making a greater impact as the land compacts and sinks (González and Törnqvist 2006). Louisiana's coastal wetlands will need a much greater vertical accretion rate, meaning a much larger rate of sediment deposition, in order to survive the changing climate (Blum and Roberts 2009; Day et al. 2011; Glick et al. 2013). As Louisiana looks to the future with climate change the outlook is grim as the current rate of temperature increase from anthropogenic climate change is tracking the upper level predictions from the International Panel on Climate Change (IPCC) (McCarthy 2009).

## Legislative History

For much of the eighteenth and nineteenth centuries European and American settlers in Louisiana viewed wetlands as hazardous to people living in their vicinity due to the belief that wetlands released "toxic" air or miasmas that could cause disease (Colten 2005; Grunwald 2006; Kelman 2006; Morris 2012; Willoughby 2018). It wasn't until the early twentieth century that the

true disease vector of the swamps, the mosquito, was properly identified (Crosby 2007; Willoughby 2018). Afterwards, wetlands were no longer viewed as a public health hazard, though they were still viewed as a public nuisance. Many land speculators continued to promote the drainage of wetlands for development purposes, for example the drainage of the wetlands in what is now the Lakeview and New Orleans East neighborhoods in New Orleans (Campanella 2008) or for agricultural uses, such as the drainage of wetlands south of Lake Okeechobee (Grunwald 2006; Hollander 2008). Outside of drainage for development in New Orleans, coastal wetlands in the rest of southern Louisiana were viewed as a hazard that made it more difficult to get to the fossil fuel resources encased beneath (Theriot 2014; Houck 2015).

The view of wetlands began to change by the 1970s as scientists began to better understand the value of wetlands. No longer were they considered solely a hinderance to oil and gas exploration, now they were beginning to be seen as a valuable resource that provided vital fisheries and fish nurseries, water purification, and, most importantly for southern Louisiana, a barrier to the flooding that frequently threatens the region (Theriot 2014; Houck 2015). For two centuries Louisianians had been working to drain their wetlands, with much success, but the tide had shifted to preserving them with the creation of land entities such as the Jean Lafitte National Historical Park and Preserve and the Bayou Sauvage National Wildlife Refuge (Colten 2005). Unfortunately though, by the 1970s researchers had also established that wetlands of Louisiana were disappearing at an alarming rate (Gagliano et al. 1970; Gagliano 1973; Hallowell 2001; Tidwell 2005; Theriot 2014; Houck 2015; Colten 2018).

Environmental issues came to the forefront of the national agenda in the late 1960s and early 1970s. Multiple environmental disasters in the preceding decades, in addition to wetland

losses in Louisiana, including the Santa Barbara Oil Spill of 1969, the loss of wetlands in the Everglades of Florida, and the environmental degradation of the Chesapeake Bay, brought attention to the on-going environmental damage due to industry practices and poor land-use decisions. The public across the United States began to call for federal legislation to save and restore the environment, leading to the passage of the Estuary Protection Act in 1970 and the Coastal Zone Management Act of 1972 (Gotham 2016). But while action was occurring at the federal level, the idea of environmental protection was slow to take hold in Louisiana given the influence oil and gas interests had on state politicians (Houck 2015). Exacerbating the slow uptake of environmental protection was the perception among many Louisiana coastal landowners that their land was not a resource in and of itself as was commonly believed by coastal landowners in other parts of the country. In Louisiana, coastal landowners viewed their land as a means to access the true resource they valued: oil and gas royalties (Houck 2015). The wetlands in place at the time were viewed as an obstruction to obtaining those royalties, so few landowners were concerned about wetland erosion in the 1970s (Houck 2015). The canals oil and gas companies dug to crisscross the wetlands in search of fossilized carbon resources, canals that accelerated the ingress of salt water into freshwater marshes and eroded the land, were left unrestored, often at landowners' request as there might be future need for them by the oil and gas companies (Zebrowski and Leach 2014; Houck 2015).

Environmentalism did finally arrive in Louisiana by the 1980s with the state legislature's decision to consolidate the environmental activities of the state into a new state level agency called the Department of Environmental Quality (DEQ) (Zebrowski and Leach 2014). The influence of oil and gas still maintained a strong hold though as the Office of Conservation,

located within the state's Department of Natural Resources (DNR), was designated as the office through which drilling permits and related regulations, were managed (Zebrowski and Leach 2014; Houck 2015). In Louisiana the very office that in other states worked to conserve and restore the landscape was instead working to hasten its destruction. This is essentially regulatory capture, when a regulatory agency, instead of acting in the public interest, acts in the interest of commercial or special concerns dominant in the industry it is tasked with regulating (Bernstein 1955; Makkai and Braithwaite 1992; Zinn 2002; Dal Bó 2006). Many officials within the DEQ and DNR went on to positions with oil and gas industry, others were appointed to positions within both agencies after working in industry (Houck 2015). For years the focus of the Office of Conservation was to process permits for oil and gas development as quickly as possible, regardless of the location where dredging would occur (Houck 2015). It was rare that permit applications were denied, for example during the first two years only four applications out of 3,600 were denied, and those for reasons unrelated to the proposed dredging activities (Houck 1983; Houck 2015). As Paul Templet, who served as secretary of the DEQ in the late 1980s, said, "As long as you have permitting in [the] DNR, you're not going to see permits being denied" (Houck 2015). As of 2020, permitting remains under the purview of the DNR (Office of Conservation: Permit to Drill Applications).

Environmental efforts at the state level moved at a glacial pace during the 1980s, prompting prominent concerned citizens to form their own advocacy organization, aptly named The Coalition to Restore Coastal Louisiana (CRCL) (Hallowell 2005; Tidwell 2003; Theriot 2014). Their report published in 1988, *Coastal Louisiana: Here Today and Gone Tomorrow,* brought widespread attention to the vanishing coastline and informed many in the public for the

first time of the true precariousness of the ecological situation facing the region (Tidewell 2003; Theriot 2014; Houck 2015). This report, and the outrage that it stoked, contributed to the federal passage of the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), also known as the Breaux Act due to United States Senator John Breaux of Louisiana co-sponsoring the bill (Tidwell 2003; Theriot 2014). The passage of the Breaux Act demonstrated the success of the Louisiana congressional delegation at nationalizing the problem of, and thus the financial cost to fix, coastal erosion in Louisiana through linking the loss of state wetlands due to the actions of the federal government (Colten 2018). The Louisiana congressional delegation proclaimed Louisiana's wetlands to be a national treasure and since 40% of the country's wetlands were located within the state, as well as the oil and gas reserves buried underneath those wetlands that the country also needed, Louisiana would need federal funds to help preserve and restore them (Colten 2018).

The Breaux Act granted Louisiana a federal appropriation of $40 million annually and built a federal-state partnership that required the multiple federal and state agencies involved with restoration efforts to work together, including at the federal level the U.S. Fish and Wildlife Service, the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Army Corps of Engineers, as well as the Louisiana Department of Natural Resources and the State of Louisiana at the state level (Hallowell 2005; Theriot 2014; Gotham 2016; Knox 2017). Another requirement of the Breaux Act was for Louisiana officials to create a comprehensive coastal restoration plan that identified individual projects that would be considered priorities for funding, which was published in 1993 as *The Louisiana Coastal Wetlands Restoration Plan* (Theriot 2014; Knox 2017).

As the 1990s progressed it became apparent that the $40 million dollars per year the Breaux Act provided for coastal restoration was a mere drop in the bucket compared to the problem and no net wetland gain had been accrued despite restoration activities (Peyronnin et al. 2013; Theriot 2014; Gotham 2016). This continued land loss led CWPPRA and the state to develop another coastal restoration plan in 1998, *Coast 2050: Toward a Sustainable Coastal Louisiana.* State leaders viewed the *Coast 2050* plan as a bold vision of the actions the state needed to take to preserve its coastline for residents in the year 2050 (Tidwell 2003; Hallowell 2005; Theriot 2014; Knox 2017). Many of the strategies outlined in the plan were not new or revolutionary, they had been included in previous plans already (Hallowell 2005; Theriot 2014). The price tag for the new plan was not cheap either, estimated at roughly $14 billion dollars, with the state unable to cover the tab (Tidwell 2003; Hallowell 2005; Theriot 2014).

The state of Louisiana has also formed multiple committees, task forces, and advisory commissions, themselves all producing reports on how the state and various governmental entities should respond to the coastal erosion crisis (Hallowell 2005). Consequently, by the twenty-first century coastal erosion in Louisiana was either being studied or responded to by a convoluted web of federal, state, and local governments as well as other non-profit stakeholder groups (see Table 3.1) (Knox 2017). Another complication has been the lack of funding availability and political will to actually implement the recommendations of the many reports. If Louisiana were to fund coastal restoration work, to implement the recommendations of the many plans/reports previously produced, politicians in Baton Rouge would need to significantly raise taxes throughout the state, which many are loath to do. Politicians in Baton Rouge have also been reluctant to propose and pass stronger environmental protection legislation or to push for

the enforcement of already existing laws in Louisiana regarding the responsibilities of companies to restore the ecological damage caused by oil and gas extraction (Zebrowski and Leach 2014; Houck 2015). This is considered to be extremely politically unpalatable given the close relationship the industry has historically had with those in power in Baton Rouge (Houck 2015). Given that the billions of dollars in funding needed to tackle the problem, and the state-level political will, have proven elusive over the last few decades, the state's response has been to organize group after group, each including many of the same stakeholders, to study the problem and produce a multitude of reports on the courses of action (Hallowell 2005; Theriot 2014).

**Creation of the Coastal Master Plan**

The 2005 hurricane season vividly demonstrated the consequences of Louisiana's disappearing wetlands (CPRA 2007; Beven et al. 2008; Knabb, Brown, and Rhome 2011; Knabb, Rhome, and Brown 2011; Houck 2015). In the aftermath of Hurricanes Katrina and Rita in 2005, it appeared that the problem, politics, and policy streams (see Kingdon 2010) related to coastal erosion had aligned during the window of opportunity that opened due to the immense damage caused by these hurricanes. The state of Louisiana vowed that it was time to work towards saving its crumbling southern coast line (CPRA 2007; CPRA 2012). Towards that end, state legislators restructured the state's Wetland Conservation and Restoration Authority to develop a centralized authority for coastal restoration efforts and flood control in the state, the Coastal Protection and Restoration Authority (CPRA), and charged it with developing and implementing a comprehensive coastal protection plan to help restore and sustain the coast (CPRA 2012). A goal of this Authority was to create a master plan document to guide these efforts that would be

updated every five years to reflect new scientific information and lessons learned (CPRA 2012). The first Master Plan was published in 2007, but was more a statement of the purpose by the Authority as the state of Louisiana was still heavily involved with the recovery efforts from the 2005 Atlantic hurricane season (see CPRA 2007). The 2012 Coastal Master Plan was the first comprehensive coastal restoration and protection plan published by the Authority and was in effect from 2012 through 2016 (CPRA 2012). The 2012 plan was also unique of the many plans written by the state that preceded it as it included specific projects that funds would be allocated to as well as combining ecosystem restoration together with flood protection (CPRA 2012; Editorial Board 2012; Wold 2012). The Authority updated this plan in 2017 to reflect scientific advances that occurred in the previous five years (CPRA 2017). A main goal of the coastal master planning process is to do things differently than the state has done before when tackling coastal environmental issues, as stated in the 2012 Coastal Master Plan: "To accommodate the dynamic nature of coastal processes, reducing flood risks and the restoration of coastal Louisiana is an evolving process. The master plan should lay the groundwork for an effective monitoring and evaluation process that seeks to reduce scientific and engineering uncertainty, assesses the success of the plan, and supports the adaptive management program. The plan will be revisited regularly, as mandated by legislation, and after exceptional events such as hurricanes. The plan will also be refined as necessary to respond to changing economic, social, environmental, and climatic conditions."

It is too early to tell if the 2012 Coastal Master Plan will be more effective than previous plans but there are some promising signs. This plan is more encompassing of the environmental problems in the state through linking the ecological significance of the coastal wetlands to flood

control. The plan document is also part of an on-going planning process which updates the coastal master plan periodically, making it more of a living document that can adapt to uncertainty and improved ecological knowledge of the coastal wetlands as a system. The citizens of Louisiana are also aware of the consequences of coastal land loss in a more visceral way than they have previously been as a result of the 2005 hurricane season and other flood events since. Residents of southern Louisiana are experiencing more damage to their homes and businesses then in previous decades as the cumulative effects of the wetland loss become felt. The 2012 Coastal Master Plan served as a focusing document for funds the state received from the BP oil spill settlement, GOMESA, and other federal sources, providing a road map of restoration projects that the funds should be used for, even though the plan was not entirely funded during its tenure.

**Key Component of the Coastal Master Plan**

A key component of the coastal master plan is the large-scale sediment diversions, originally two sediment diversions off of the Atchafalaya River — the Atchafalaya Diversion and the Increase Atchafalaya Flow to Eastern Terrebonne Diversion — and eight sediment diversions off the Mississippi River — the Lower Breton Diversion, the Upper Breton Diversion, the Central Wetlands Diversion, the Mid-Breton Diversion, the West Maurepas Diversion, the Mid-Barataria Diversion, the Lower Barataria Diversion, and the Bayou Lafourche Diversion— in the 2012 plan (Figure 3.12) (CPRA 2012). The 2017 plan kept the same planned river diversions for the Atchafalaya Basin but increased to nine diversions off of the Mississippi River

while also removing some planned diversions and adding the new diversions of East Maurepas, Manchac Landbridge, Union Freshwater, and Ama to the previously planned Lower Breton, Central Wetlands, Mid-Breton, Mid-Barataria, and Bayou Lafourche Diversions (CPRA 2017). A sediment diversion is a man-made channel off of a river with purpose of diverting river water containing dissolved sediment into a coastal ecosystem (Bentley, Freeman, Giosan, Willson, and Cable 2012). Figures 3.13 and 3.14 show the planned location of one of the diversions, the Mid-Barataria, and what the structure is expected to look like once completed. Sediment diversions are not a new concept for the 2012 Coastal Master Plan; they have been a component of several of the previous restoration plan iterations the state has conceived. The idea of utilizing the Mississippi River to restore eroding coastal wetlands was first suggested by Gagliano et al. (1970) and has been considered by state officials as a necessary component for successful coastal restoration ever since (CPRA 2012; CPRA 2017; Russell 2018; Colten 2018).

**The US Army Corps of Engineers and Louisiana**

A key first step for CPRA will be to coordinate with the US Army Corps of Engineers (USACE) as they are in charge of maintaining the Mississippi Rivers and Tributaries Project levees, which would need to be breached and reworked at the location of each proposed sediment diversion. The USACE has a long history in Louisiana, dating back to the 1824 US Supreme Court decision in *Gibbons* v. *Ogden*. The Supreme Court ruled in this case that federal authority over interstate commerce extended to riverine navigation as well (Shallat 1994; Reuss 1998; O'Neill 2006; Doyle 2018). Congress passed legislation afterwards that authorized the USACE to make river and harbor improvements along the country's major rivers, including the

Mississippi (Shallat 1994; Reuss 1998; O'Neill 2006; Doyle 2018). Louisiana also began requesting federal funds to combat the frequent flooding the state experienced from the Mississippi River as the floods hurt the economy of the state and affected commerce for all the shipped goods downstream to New Orlean (Reuss 1998). Congress was unwilling to authorize funding for flood control in Louisiana as that was viewed as going beyond the navigation and interstate commerce requirements of *Gibbons* v. *Ogden* (Reuss 1998; Doyle 2018).

By 1850 though Congress did begin to bend some on the issue of flood control on the Mississippi River, in part because of lobbying from Louisiana politicians and boosters, and authorized a survey of the Mississippi River Valley for the purposes of providing recommendations on how to prevent flooding and to permanently clear a navigation channel at the mouth of the river (Shallat 1994; Barry 1997; Reuss 1998; O'Neill 2006; Doyle 2018). The outcome of this survey was ultimately the "levees only" policy that dominated USACE thinking about the Mississippi River (Barry 1997; Reuss 1998). The idea was that by constraining the river to its channel with levees it would run faster, scouring a deeper river bed that would not only reduce the risk of flooding but improve navigation along the river (Barry 1997; Reuss 1998). Politicians and boosters from Louisiana used this policy to further their efforts at nationalizing their local flood control problems by requesting federal funds to build the necessary stronger levees along the banks of the Mississippi (Reuss 1998). These efforts were supported by officials in the USACE as they viewed federal funding as the best way to standardize the levees throughout the river valley (Shallat 1994; Reuss 1998).

The Great Flood of 1927, and the Flood Control Act of 1928 that followed, markedly increased the involvement of the USACE in Louisiana (Barry 1997; Reuss 1998; Colten 2005;

O'Neill 2006; Campanella 2008; Doyle 2018). With the passage of the Flood Control Act of 1928, the state of Louisiana succeeded in federalizing the vast bulk of its flood control infrastructure that private land owners and local levee boards had been unwilling to fund themselves (Reuss 1998; O'Neill 2006; Shallat 2014). The USACE would be in charge of managing the Mississippi River Basin and preventing flooding, all at the expense of the federal government. This includes the Old River Control Structure, located near Point Breeze, Louisiana, that keeps the Mississippi River from jumping channels into the Atchafalaya River and abandoning its current channel past Baton Rouge and New Orleans (Reuss 1998). Hurricane Betsy in 1965 provided the impetus for the state to nationalize even more of its flood risk. The images of the widespread damage the storm caused in New Orleans led to Congress passing legislation assigning to the USACE the responsibility of designing and building a system of levees to protect the city and surrounding environs (Colten 2009). By the end of the twentieth century, the state of Louisiana had a well-established pattern of turning to the federal government and the USACE to fund and build large-scale flood control infrastructure, in essence federalizing the cost but privatizing the benefits of the economic development resulting from said infrastructure. There are those concerned that the proposed sediment diversions, which as mentioned earlier would require the involvement of the USACE to build and operate, are in line with previous USACE projects the state has supported that ultimately ended up being more of a detriment than a solution to a problem, which is one of the points of conflict regarding the diversions (Turner 2009; Tierney 2020).

## Figures and Tables

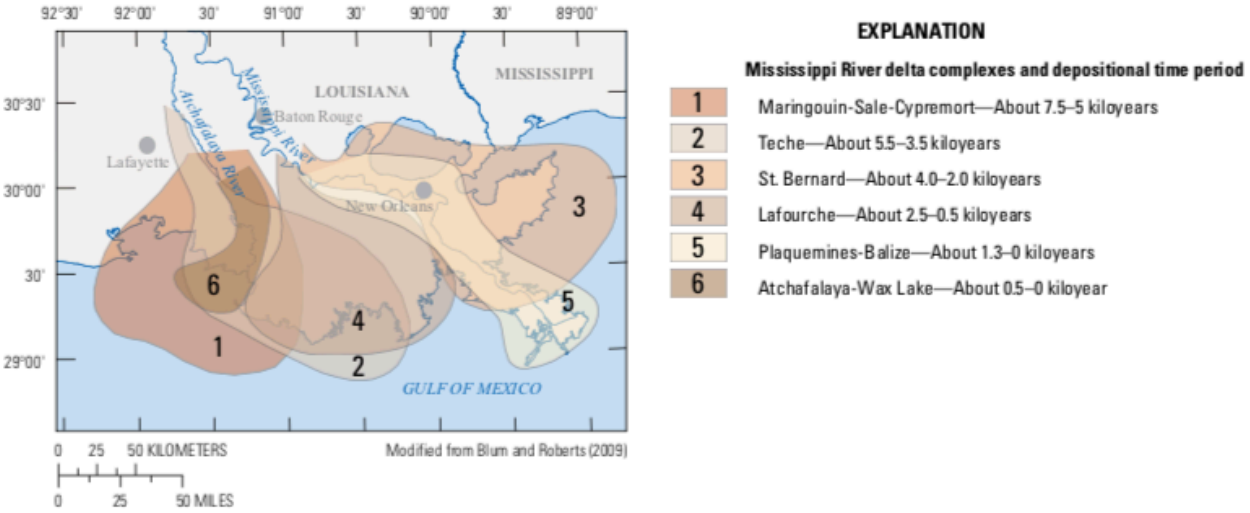


Figure 3.1: Map of the different deltaic lobes of the Mississippi River in the past seven and a half thousand years (Alexander et al. 2012). Note that both Lobe 5, the Plaquemines-Balize Delta Complex, and Lobe 6, the Atchafalaya-Wax Lake Delta Complex, are currently active deltaic lobes with deposition occurring.

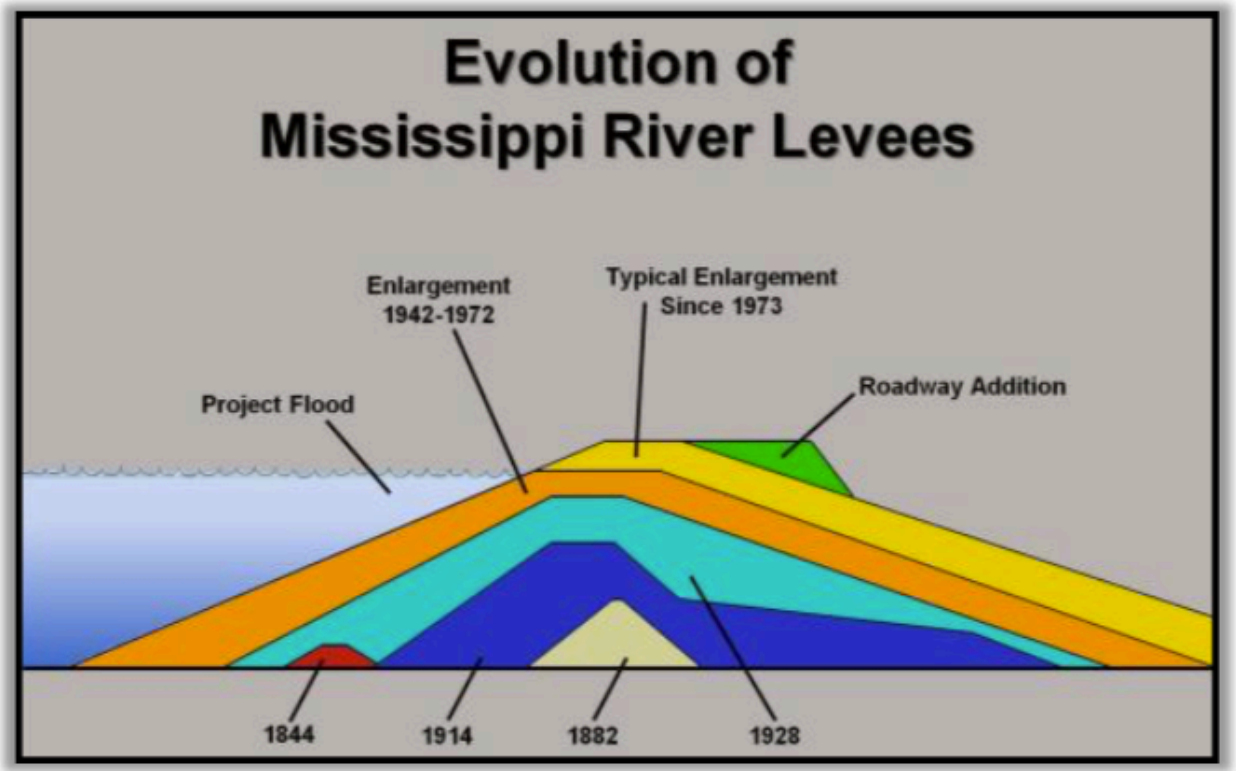


Figure 3.2: A cross-section of the present-day mainstem Mississippi River levees that run from Cape Girardeau, Missouri to Venice, Louisiana. They are built of clay and other soils, are armored with articulated concrete mattress revetment to prevent erosion, and are approximately trapezoidal in shape. The different colors represent the additions to the river levees built during the 19th and 20th centuries (U.S. Army Corps of Engineers).

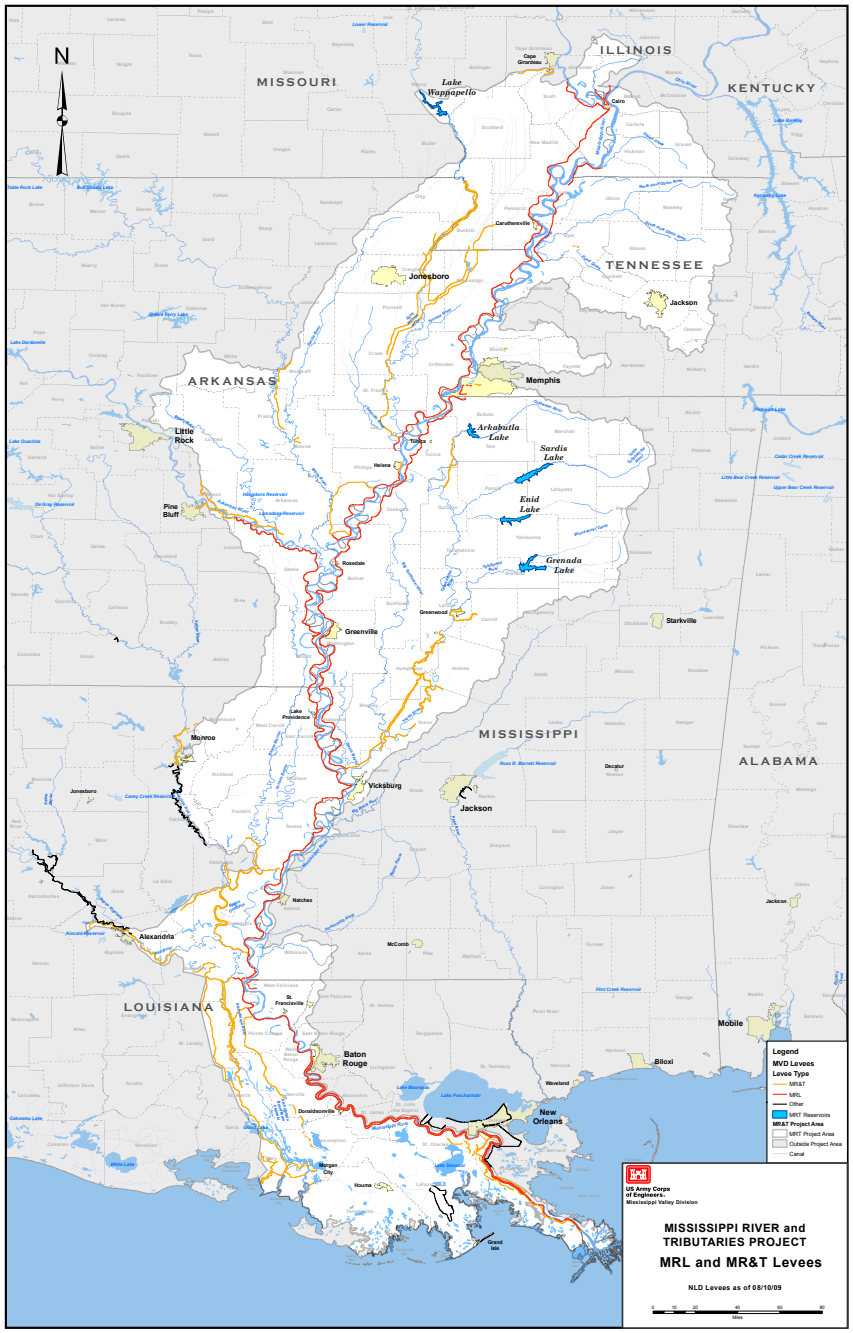


Figure 3.3: Map of the Mississippi River and Tributaries Project levees built by the US Army Corps of Engineers. The red lines indicate mainstem Mississippi River levees while the orange lines indicate levees on Mississippi River tributaries (US Army Corps of Engineers)

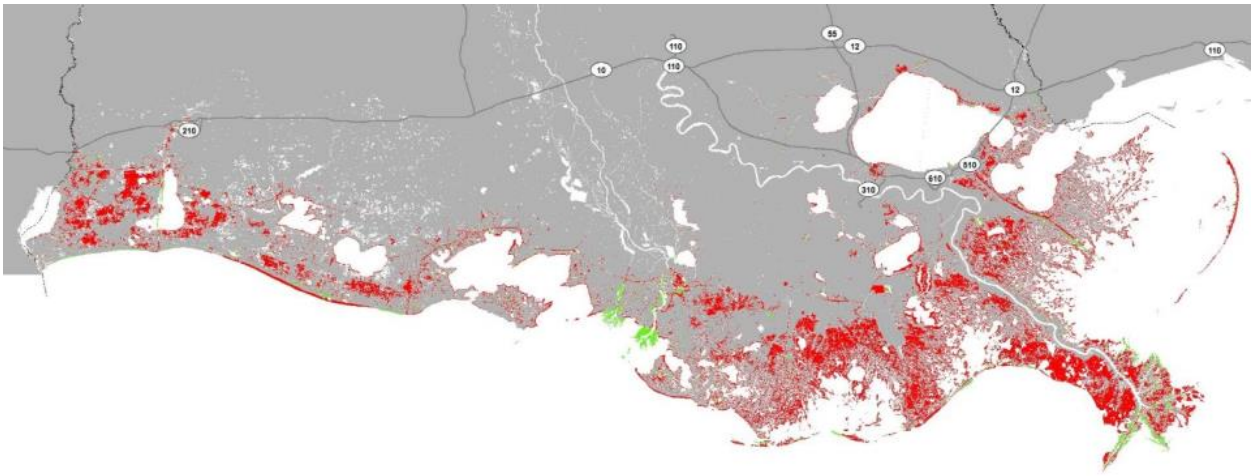

Figure 3.4: Map of the wetland loss in southern Louisiana from 1932 to 2016. The areas shaded red indicate land loss while green shaded areas indicate land gain (Couvillion et al. 2017).

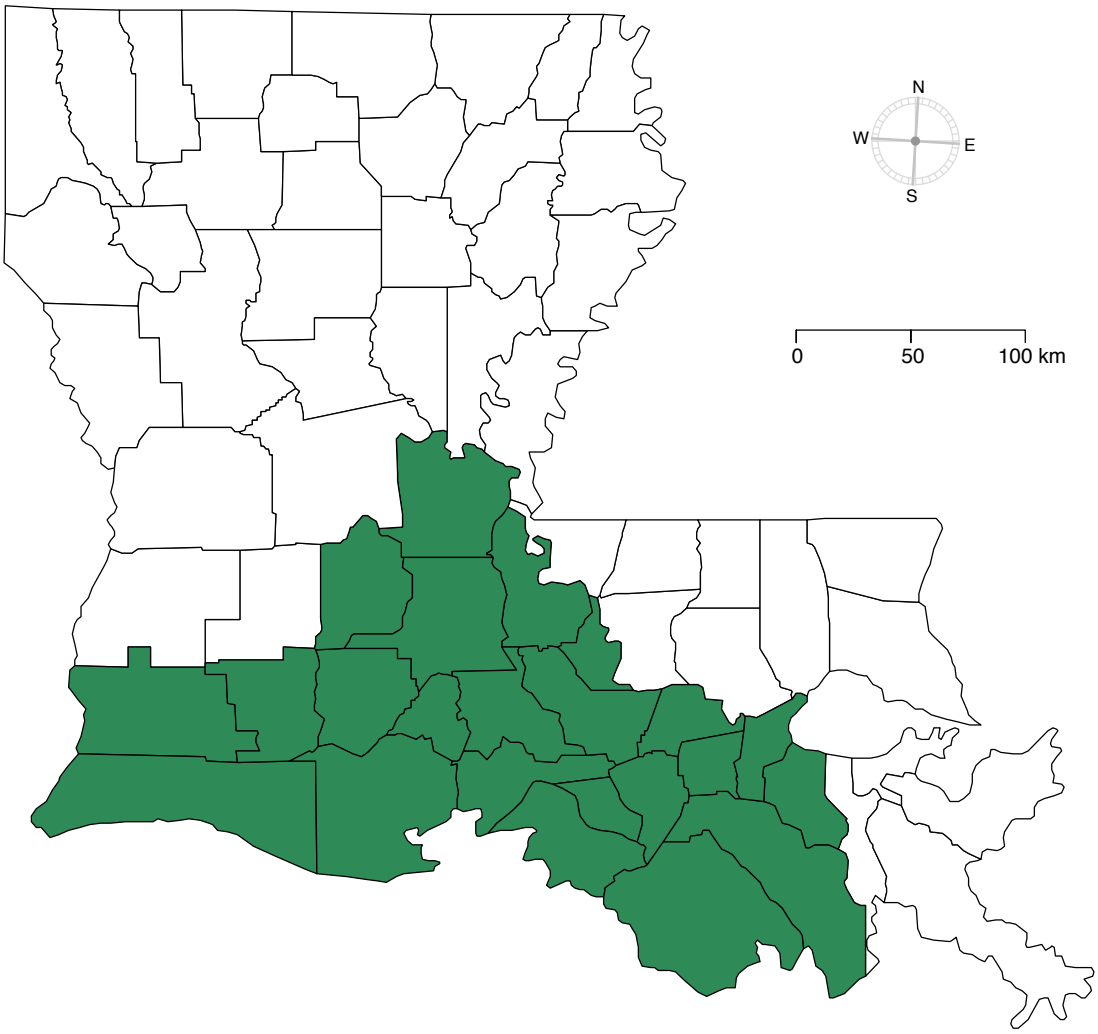


Figure 3.5: Map of the parishes in Louisiana that are considered part of the Acadiana region of the state, including Acadia, Ascension, Assumption, Avoyelles, Calcasieu, Cameron, Evangeline, Iberia, Iberville, Jefferson Davis, Lafayette, Lafourche, Pointe Coupée, St. Charles, St. James, St. John, St. Landry, St. Martin, St. Mary, Terrebonne, Vermilion, and West Baton Rouge Parishes.

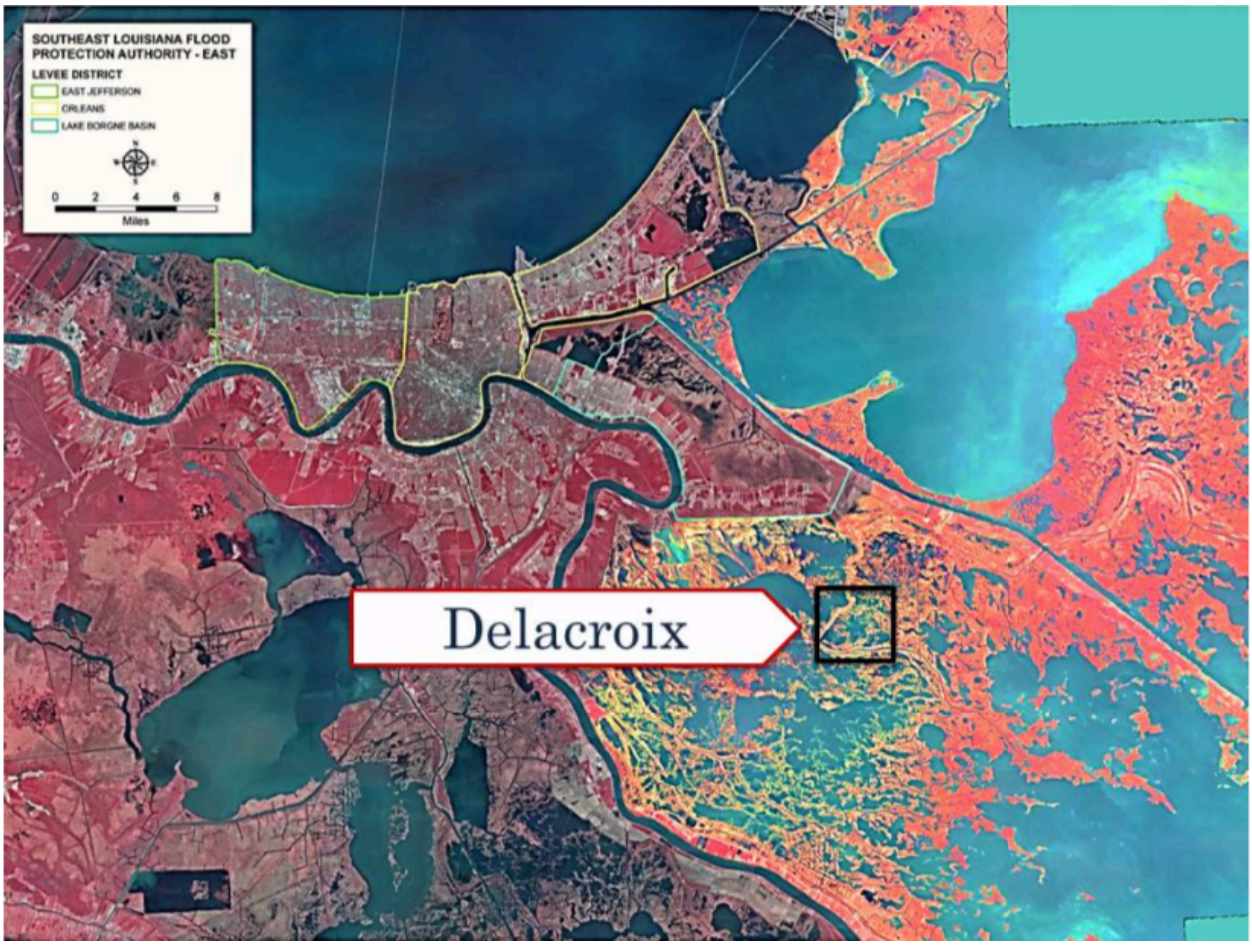


Figure 3.6: A map showing the location of Delacroix, Louisiana in relation to New Orleans (Houck 2015).

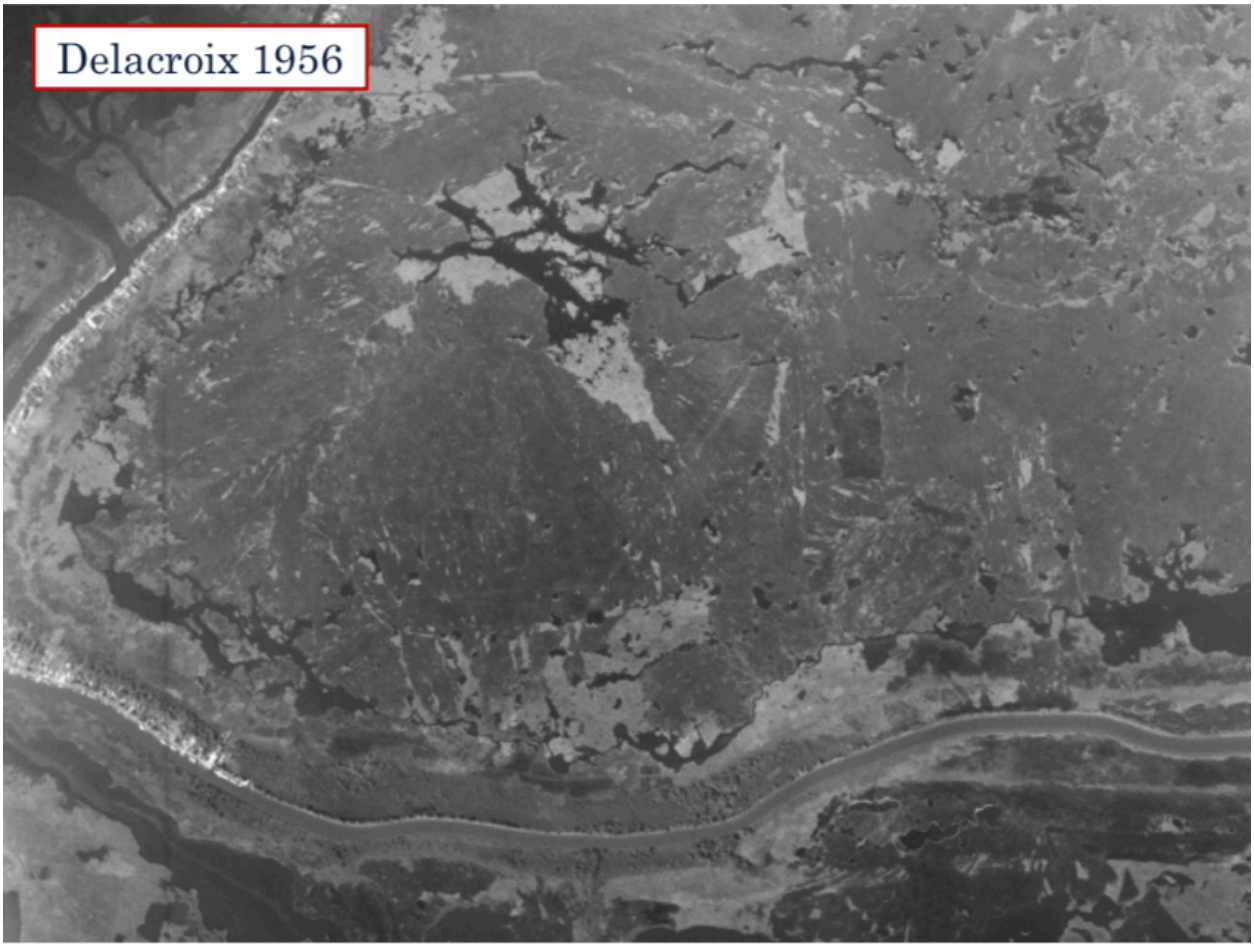


Figure 3.7: An aerial photograph of the box identified in Figure 3.6 of the wetlands near Delacroix, Louisiana, taken in 1956 before oil and gas canals had been dredged in the region (Houck 2015). The darkest colors in the photograph indicate open water, the lighter shades of gray indicate wetlands.

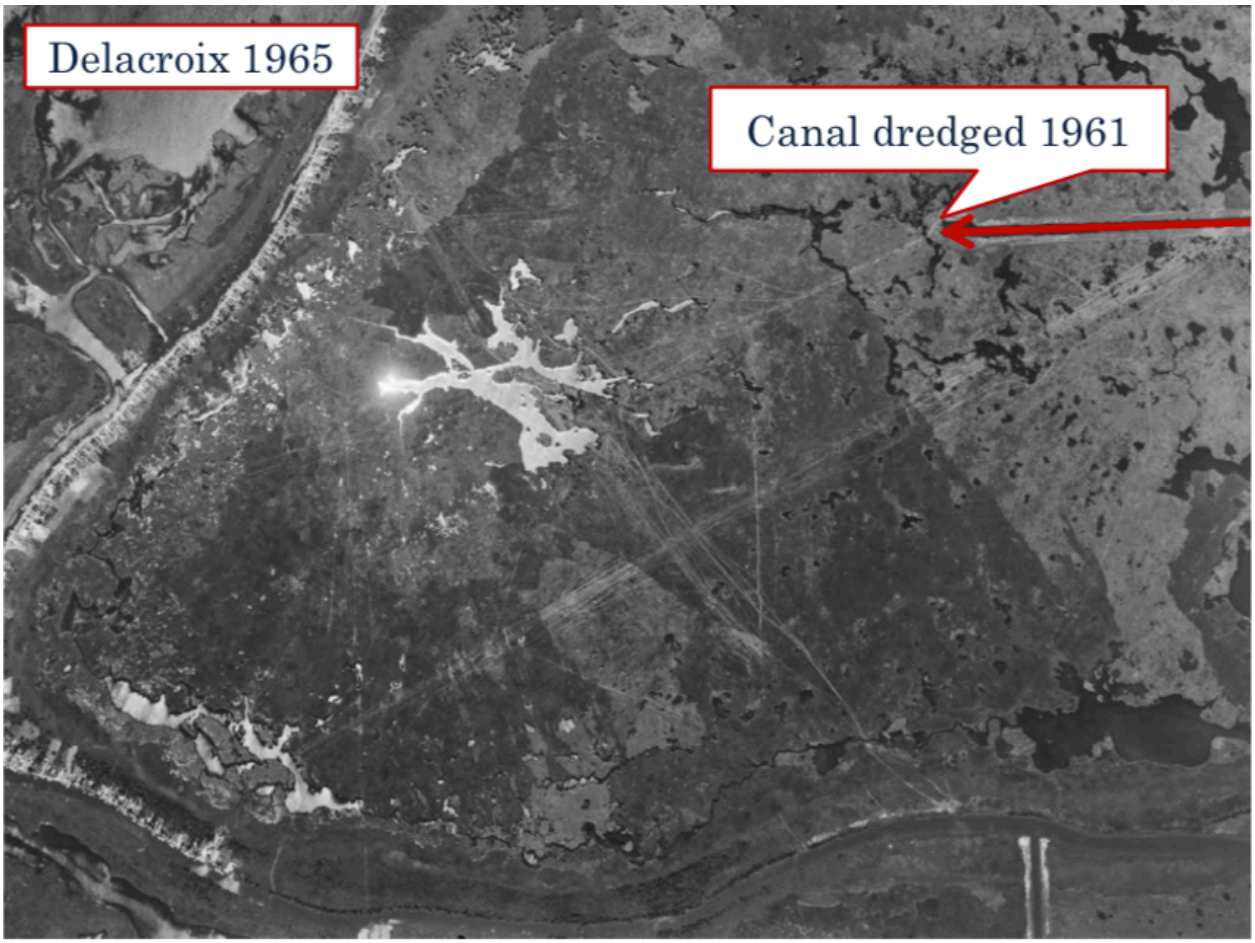


Figure 3.8: An aerial photograph of the same region identified in Figure 3.7 from 1965 (Houck 2015). A canal was dredged in the 1961 into the wetlands in the upper right part of the photograph, indicated with a red arrow. Comparing this figure with Figure 3.8 you can see the appearance of more areas of open water near the canal.

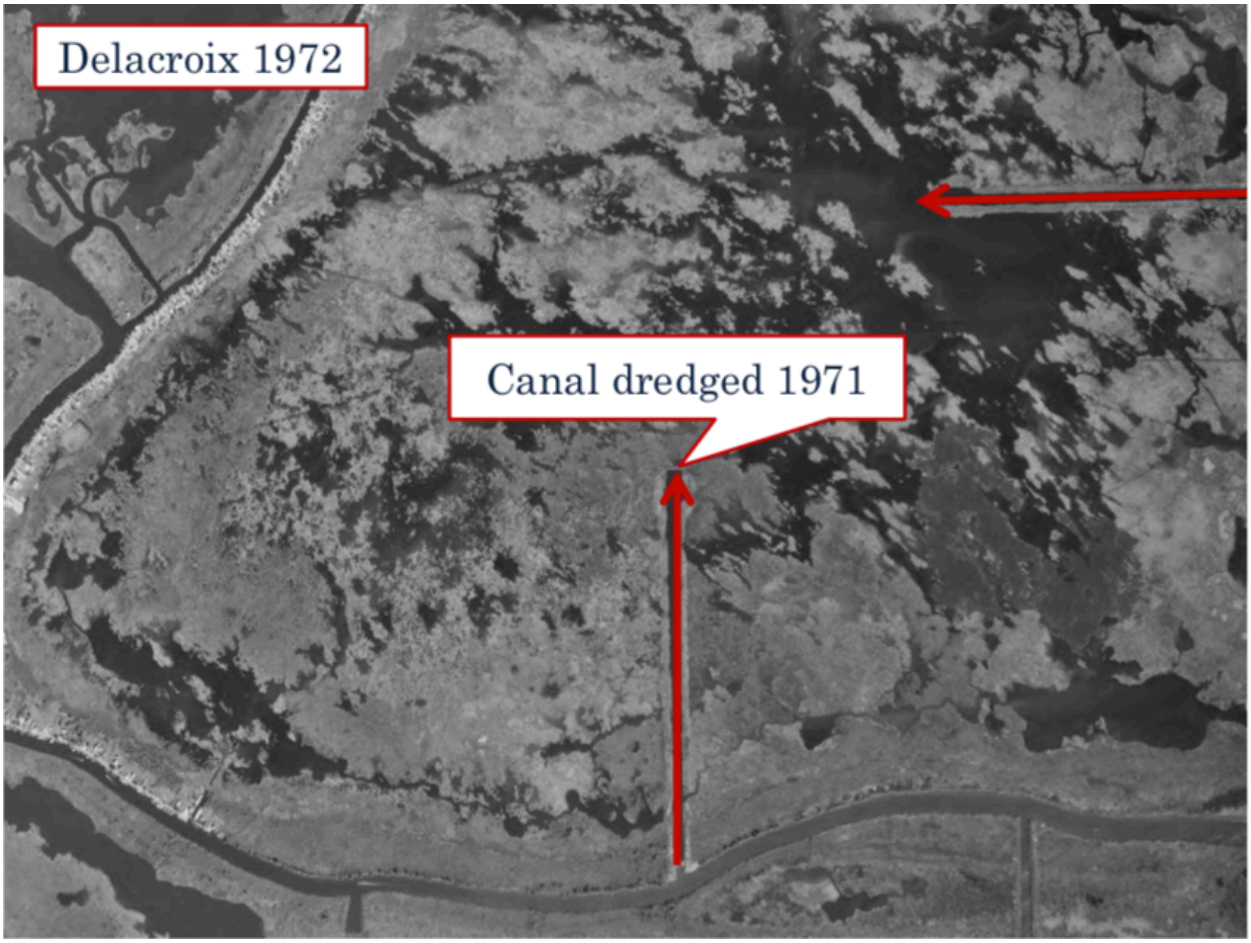


Figure 3.9: An aerial photograph of the same region identified in Figures 3.7 and 3.8 from 1972 (Houck 2015). Wetland deterioration has continued in the vicinity of the 1961 canal in the upper right portion of the photograph while a new canal in the bottom center of the photograph was dredged in 1971.

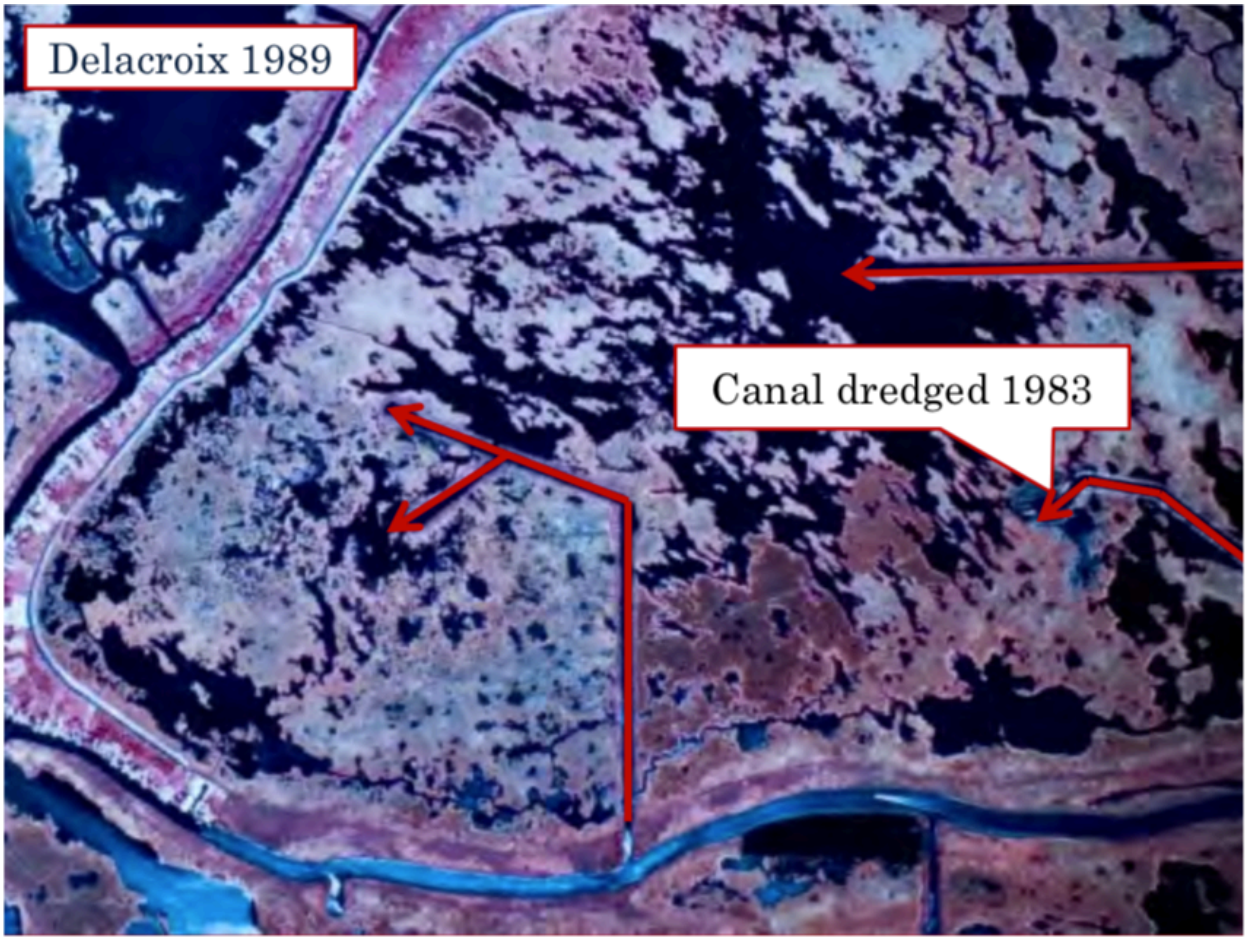


Figure 3.10: An aerial photograph of the same region identified in Figures 3.7 through 3.9, taken in 1989 (Houck 2015). Wetland deterioration has continued in the vicinity of the 1961 canal in the upper right portion of the photograph, extensive areas of open water now exist where there was wetlands 18 years ago. Wetland deterioration is also now apparent in the vicinity of the 1971 canal located in the bottom center of the photograph. A third canal has also been dredged in 1983 south of the 1961 canal, located center right. Deterioration near the 1983 canal is also visible.


Figure 3.11: An aerial photograph of the same region identified in Figures 3.7 through 3.10, taken in 2008 (Houck 2015). Widespread wetland deterioration is present across the entire region. The three canals previously mentioned in Figures 3.8 through 3.10 are clearly visible due to the straight lines of the dredge paths, but the wetlands near the canals have disintegrated into open water.

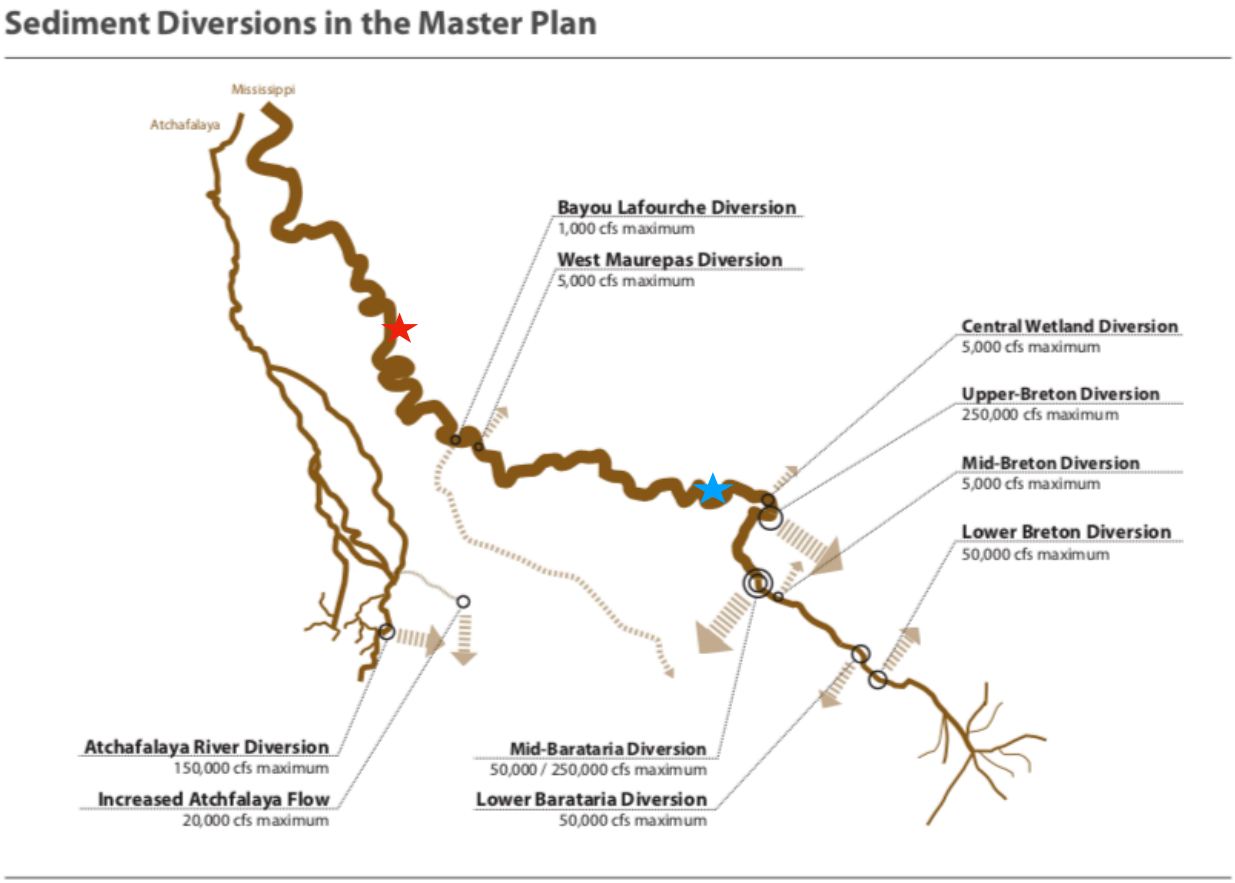


Figure 3.12: Map of showing the locations of the proposed sediment diversions of the 2012 Coastal Master Plan and the expected maximum flows of each diversion (adapted from CPRA 2012). The blue star represents the location of New Orleans, LA and the red star Baton Rouge, LA.

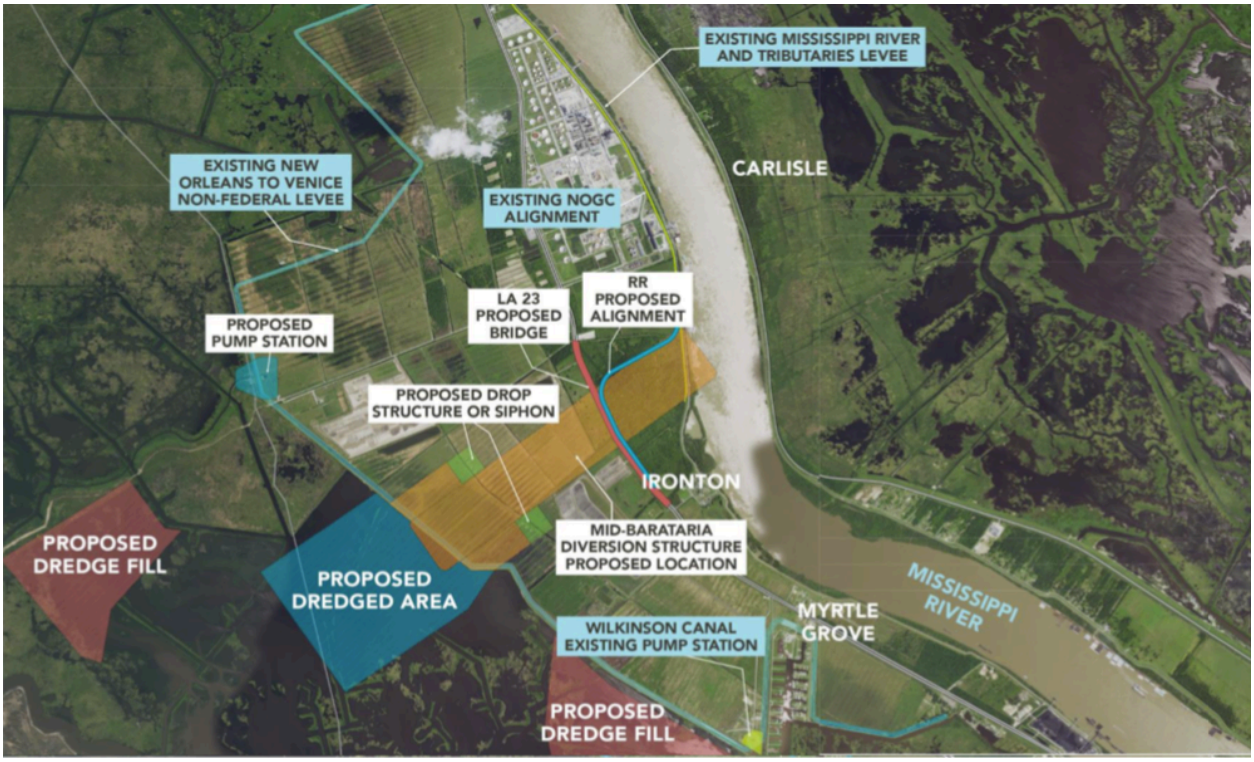


Figure 3.13: Map of the proposed location of the Mid-Barataria Sediment Diversion off the Mississippi River near Ironton and Myrtle Grove, Louisiana (Guillory 2017).

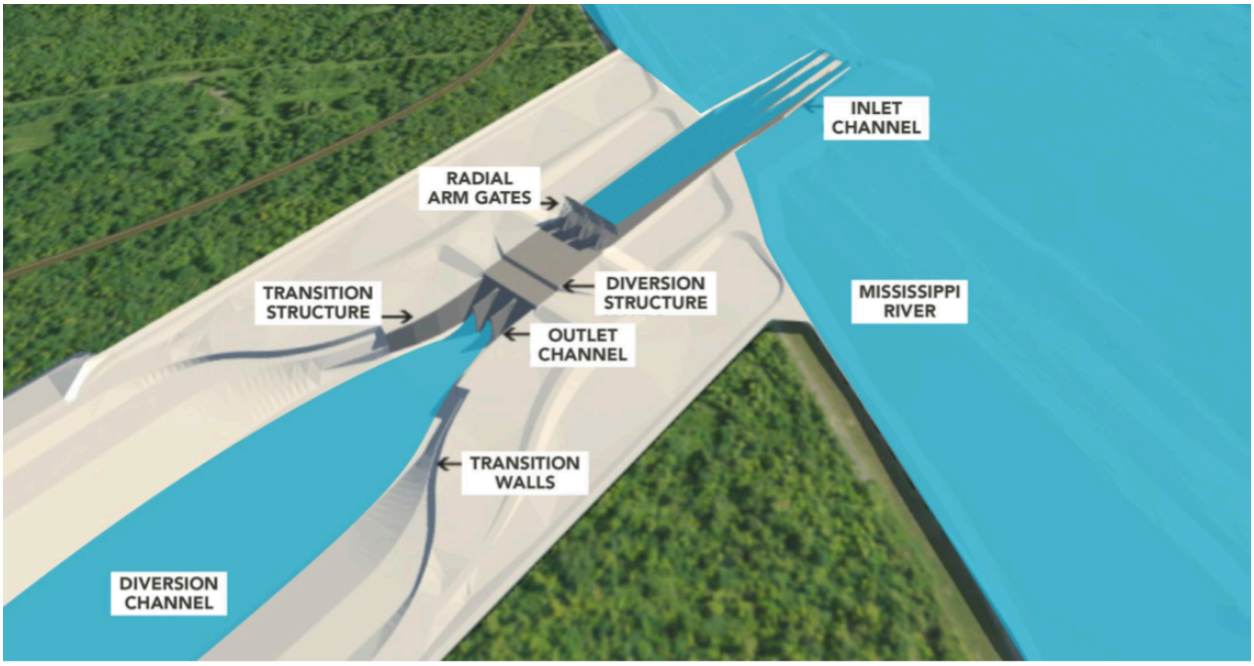


Figure 3.14: Diagram of the proposed Mid-Barataria Sediment Diversion (Guillory 2017).

| | |
|---|---|
| Federal Government | Council on Environmental Quality |
| | Environmental Protection Agency |
| | Federal Emergency Management Agency |
| | National Oceanic and Atmospheric Agency |
| | Natural Resources Conservation Service |
| | U.S. Army Corps on Engineers |
| | U.S. Bureau of Reclamation |
| | U.S. Coast Guard |
| | U.S. Fish and Wildlife Service |
| | U.S. Geological Survey National Wetlands Research Center |
| State Government | Coastal Protection and Restoration Authority |
| | Department of Agriculture and Fisheries |
| | Department of Culture, Recreation, and Tourism |
| | Department of Environmental Quality |
| | Department of Health and Hospitals |
| | Department of Insurance |
| | Department of Natural Resources |
| | Department of Public Safety |
| | Department of Transportation and Development |
| | Department of Wildlife and Fisheries |
| | Economic Development |
| | Governor’s Office of Coastal Activities |
| | Governor’s Advisory Commission on Coastal Restoration and Conservation |
| Regional/Local Government | Levee Districts |
| | Municipal Governments |
| | Parish Governments |
| | Regional Planning Districts |

| | |
|---|---|
| Native American Tribes (Federal and State Recognized) | Chitimacha Tribe of Louisiana |
| | Coushatta Tribe of Louisiana |
| | Jena Band of Choctaw Indians |
| | Tunica-Biloxi Indian Tribe of Louisiana |
| Nonprofit Organizations | America's Wetlands |
| | Audubon Society |
| | Barataria-Terrebonne National Estuary Program |
| | Bayou Rebirth |
| | Coalition to Restore Coastal Louisiana |
| | Ducks Unlimited |
| | Environmental Defense Fund |
| | Gulf Restoration Network |
| | Lake Pontchartrain Basin Foundation |
| | National Audubon Society |
| | Restore and Retreat |
| | Save Our Wetlands |
| | The Nature Conservancy |

Table 3.1: List of the different federal, state, local, and tribal government entities as well as nonprofits involved in some facet of coastal restoration work in southern Louisiana. This list should not be considered comprehensive given the dynamic nature of the organizational relationships involved with coastal restoration (Reproduced from Knox 2017)

# Chapter 4: Methods

A mixed methods approach of document analysis and semi-structured interviews was determined to be useful in investigating the research questions. Southern Louisiana continues to have an active local science journalism community in a time when many local newspapers are eliminating their science reporters (Hayden and Hayden 2018). Several local newspapers in Southern Louisiana, including *The Advocate*, *The Times-Picayune*, and *The Lens*, employed during the study period a science/environment reporter who covered a wide array of coastal science issues. This included Amy Wold at *The Advocate,* Mark Schleifstein at *The Times-Picayune,* and Bob Marshall at *The Lens.* An assumption was made that if local newspapers were covering coastal science issues with local reporters it must be due to these issues appearing relevant to the local communities and the public discussions around these topics. Based on that assumption, local newspaper articles covering the use of the science in the coastal master planning process were selected for the document analysis.

The Coastal Master Planning process has worked to involve community members in the development of the 2012 Coastal Master Plan and its subsequent iterations (CPRA 2012). To that end, there have been several focus groups formed as well as a framework development team that was composed of residents and professionals from the many stakeholder groups interested in preserving and restoring Louisiana's coastline. These working groups allowed residents to have a voice in the coastal master planning process, both in the development of the plan and also how the plan was to be implemented.

Due to the widespread nature of the coastal erosion problem in southern Louisiana, any person who lives, works, or recreates in the region will be affected and thus could be considered a stakeholder invested in the Coastal Master Plan. While the coastal erosion is frequently covered

by local media, not all of the roughly two million residents of the region are directly involved with coastal restoration. In an effort to interview those stakeholders who are directly involved, but not directly employed by the Coastal Protection and Restoration Authority (CPRA), a stratified purposeful sample (Patton 2002; Palinkas et al. 2015) of potential interviewees was contacted, composed of those individuals listed as being members of the Framework Development Team in the 2017 Coastal Master Plan, the most recent published iteration of the coastal restoration process. The goal with this type of sampling strategy is to capture major variations within the sample group, in this case stakeholders from the major industries, government agencies, and academia that are involved with coastal restoration efforts in the state. The composition of the Framework Development Team provided a potential sample of stakeholders that had a history of participating in the research process, through their participation in the coastal master planning process, it was hoped that they would thus be more receptive to participating in this study. Those directly employed by CPRA were not included in this study as the assumption was made that they would be more likely to only respond with the official "party line" that the CPRA was reporting, that the Coastal Master Plan, and the projects included therein, are the optimal path for the state to follow to respond to the coastal erosion crisis.

As discussed in Chapter 3, the CPRA came into existence due to the damage caused by Hurricanes Katrina and Rita in 2005. During the recovery process after these two disasters, the state of Louisiana and the city of New Orleans were under pressure from the federal government to present a plan to guide the rebuilding effort (Olshansky and Johnson 2010, Rivlin 2015). The federal government intensified the pressure by refusing to release the bulk of the reconstruction funding until the city had developed such a plan and was seen as "speaking with one voice" with

critical dissent being as minimized as possible (Olshansky and Johnson 2010). The Bush Administration felt justified in applying the pressure to the state as Louisiana was seen as having a history of financial mismanagement and graft (see Chapter 3, The Interconnected Causes of Land Loss, for a brief summation of this history) and there was a concern that the large sum of money needed for the recovery would be spent on projects and for purposes not connected to the recovery efforts. During this same time period, the Louisiana Legislature passed Act 8 of the First Extraordinary Session of 2005 which created the CPRA and charged it with creating a coastal master plan document to be updated every five years. Given that the coastal master plan documents are outlining the need for a sum of money on the same order that the state requested for the recovery of New Orleans, tens of billions of dollars, it is conceivable that state officials within the CPRA could be applying the same pressure for limiting dissent that was used during the New Orleans recovery plan. Investigating this possibility was viewed as beyond the scope of this study and thus decided to not include employees of the CPRA as members of the potential stakeholder group.

The planning and implementation processes are ongoing ones in Louisiana, with the coastal master plan documents representing bounded views of the current state of the plan and anticipated future directions at five year intervals. The 2017 Coastal Master Plan was the first updated planning document to be published after the 2012 Coastal Master Plan. As this study is looking at how the implementation of the 2012 Coastal Master Plan was responding to the inherent scientific uncertainty of the plan itself, I felt that the stakeholders involved with developing the 2017 plan would be better able to speak to the implementation of the previous plan than stakeholders involved with developing the 2012 plan, despite the 2012 plan being a

central focus for this work. Stakeholders involved with the development of the 2017 plan would in theory be familiar with the progress of the 2012 plan and could speak to the learning and changes that may or may no have occurred during the time period the 2012 plan was in effect.

**Document Analysis**

Newspaper articles were selected for a document analysis due to the salience of environmental policy issues to local news sources. Environmental policy is often linked to debates about political or social values, despite the scientific complexity that is often a major component of any environmental policymaking effort (Lee 1993, pg. 90; Innes and Booher 2010), and thus is covered by local news organizations. The second coastal master plan was in effect from early 2012 through late 2016 so a corpus of newspaper articles from 1-1-2012 to 12-31-2016 was collected from several major local newspapers active during that period.

Newsbank, a national online archive of local newspapers available through the Norman Public Library, provided access to the archives of *The Times-Picayune*, the major newspaper in New Orleans, as well as those of *The Advocate*, the major newspaper in Baton Rouge, and its additional Lafayette and New Orleans editions. *The Advocate* is the largest daily paper in the state. Other local papers serving the southern portions of the state were considered, such as *The Daily News* (Bogalusa), *The Daily Star* (Hammond), and the *L'Observateur* (La Place), but ultimately excluded from the corpus as they did not publish any articles during the time period that focused on the coastal master planning process or erosion issues during the above time period. Articles from *The Lens*, a non-profit investigative journalism organization, were also

included in the corpus. *The Lens* is an on-line news source covering the New Orleans area as well as the Gulf Coast.

The following search terms were used to identify potential corpus articles: "coastal master plan," "coastal erosion," "sediment diversion," "coastal restoration," and "adaptive management." "Coastal master plan" was selected as a main question in this study is how science is being utilized in the master plan as the plan is implemented to reduce and/or prevent coastal erosion and restore the coast to an equilibrium state. The main method the master plan proposes to use to achieve those goals is by large sediment diversions off the Mississippi River and the master plan proposes handling scientific uncertainty through an adaptive management strategy. Thus, with those five search terms it was felt that any news article that would be covering science or funding and the coastal master plan would be identified. The search parameters were set that any article where the search term occurred should be selected. The number of articles identified for each news source and search term are shown in Table 4.1.

All 3306 articles were read for potential inclusion into the corpus. Duplicates of articles from the same newspaper were eliminated as well as articles where the main focus was not on science or the financial aspects and the coastal master planning process. Many articles that mentioned the search terms focused on another topic, such as the BP Deepwater Horizon Oil Spill, the lawsuit against oil and gas companies filed by the Southeast Louisiana Flood Protection Authority-East, or local/state elections, and only briefly mentioned coastal erosion or the master plan. This process led to a reduced corpus of 385 articles. At the beginning of data collection, the method of analysis was expected to be the Narrative Policy Framework (Jones and McBeth 2010; Jones, Shanahan, and McBeth 2014), a positivist, quantitative, and structuralist

method for studying the policy narratives around a topic that decision-makers use to make sense of their policy reality. This framework allows for socially constructed narratives around science to be systematically studied (Jones and McBeth 2010; Jones, Shanahan, and McBeth 2014). Once the corpus of newspaper articles was finalized this method was no longer viewed as appropriate for the analysis. Many of the newspaper articles did not include enough components of a narrative, as defined in Jones, McBeth and Shanahan (2014), for the Narrative Policy Framework to be a useful analytical method (Shanahan et al. 2013; Shanahan et al. 2014). After reading through the corpus articles once more, and considering the research questions, qualitative content analysis (Schreier 2012) was determined to be a more appropriate method for this component of the study.

Qualitative content analysis (QCA) was selected primarily for its strength in categorizing and reducing large amounts of text to fewer content categories in a systematic way (Schreier 2012; Roller 2019). QCA is a flexible method that allows the incorporation of both theory and empirical observations from the data collected into the development of the coding frame (Schreier 2012; Kuckartz 2019). QCA is a method best used to describe and summarize data in a systematic way, and is a good choice when research questions are descriptive in nature (Mayring 2000**;** Schreier 2012), as they are for the document analysis portion of this study. QCA as a method is still relatively new to Anglo-American scholars as much of the literature developing this method has been published in German in the post WWII era (Schreier et al. 2019; Prasad 2019; Kuckartz 2019). This is in spite of the fact that the seminal paper introducing QCA was published in English in 1952 (see Kracauer 1952) as a response to Berelson's (1952) introduction and definition of quantitative content analysis. It has only been in the last few decades that

German methodology scholars working in this area have begun publishing works in English (see Mayring 2000; Schreier 2012) that the international social science research community has become more aware of this version of content analysis (Schreier et al. 2019; Prasad 2019; Kuckartz 2019).

QCA differs from the commonly known content analysis variant in the Anglo-American spheres, quantitative content analysis, in several important ways, though both methods can be viewed as being at opposite ends of a spectrum of content analysis (Morgan 1993; Schreier 2012). A key similarity of both QCA and quantitative content analysis is the use of a consistent set of codes to categorize and reduce the data, but there are key differences (Morgan 1993). QCA is a much more descriptive method where many of the codes used are developed through close reading of the data and the focus is more on latent meanings within the data (Morgan 1993; Schreier 2012). While numerical counts of codes is used in QCA, these counts are typically considered the end of the descriptive process with the data and the starting point for further analysis in interpreting the pattern(s) the codes present (Morgan 1993; Schreier 2012; Prasad 2019). More content about the data is needed in QCA, such as information about the creation of the texts or interviews being analyzed or the background of the problem being studied in that location. Table 4.2 provides a summary of the differences between the two types of content analysis.

There are things to consider when selecting and using QCA. The advantage of this method in summarizing and reducing large qualitative data sets comes with a price, the loss of potential multiplicity of meanings within the data set (Schreier 2012). The process of building a coding frame in QCA requires that each unit of coding be exclusive to the category or code it is

assigned in that dimension. This negates the possibility of interpreting the unit of coding multiple ways within a dimension (Schreier 2012; Schreier et al. 2019). Specific to this study, such a coding scheme would omit second dimension code interactions where an article discusses more than one second dimension code. Another feature to keep in mind is that unlike quantitative content analysis, QCA is not a particularly good method for hypothesis testing as the focus while developing the coding frame is on describing the data, thus all the data collected is used in developing the coding frame instead of only using a percentage of the data and testing the frame on the remaining data (Schreier 2012). Unlike methods such as discourse analysis, which focuses on how social reality is constructed using, or not using, language, QCA is concerned with describing what is actually present in the data (Schreier2 2012). It can be considered a first step in the process of more abstract methods such as grounded theory, but the focus of QCA is more on description than on theory generation (Schreier 2012; Mayring 2019**;** Marvasti 2019).

Following the typology of QCA defined in Hsieh and Shannon (2005), a directed QCA was used to develop the coding frame, where codes are developed from peer-reviewed literature and the data collected. The main categories of the coding frame, "science" and "funding" were developed conceptually from reading the 2012 Coastal Master Plan and the researcher's background in earth science and meteorology. These two categories represented the two areas of uncertainty that were most likely to affect the implementation of the 2012 plan. Two sub-category codes dealing with uncertainty under "science" were also developed conceptually at this stage, "sediment diversions" due to the lack of published peer-reviewed literature on this topic, and "climate change" because of the plethora of government reports and peer-reviewed literature discussing the range of possible outcomes as the planet warms (see Figure 4.1 for the conceptual

coding frame). The unit of coding for this study was the newspaper article. The data-driven codes of the coding frame were developed using subsumption (Mayring 2010, as described in English by Schreier 2012). Once a unit of coding had been assigned to one of the main categories, it would be checked to see if it was comparable to an existing sub-category, in which case it would be coded, or 'subsumed,' under that category. If the unit of coding was not comparable, it represented new information for the coding frame and a new sub-category would be created. This process was repeated until all the newspaper articles were incorporated into the coding frame. Once all the sub-categories were developed, the coding frame was revised for clarity and conciseness where necessary (see Table 5.2 for the complete coding frame).

Schreier (2012, Ch. 9) presents two different strategies for handling coding reliability, inter-coder reliability, the level of coding agreement between two different coders, and intra-coder reliability, the level of coding agreement of one coder between different points of time. The latter method is suggested for those who are working on their own, with a time span of at least ten to fourteen days between the first and second coding passes (Schreier 2012). Schreier (2012) and Prasad (2019) identify several papers that are considered to be well-done examples of the QCA (see Bischoping 1993; Kapustka et al. 2009; McDonald et al. 2009; Lópex et al. 2011; Heil 2011). Of these studies, all but Heil (2011) used inter-coder reliability, either quantified or through discussion with the research team. Heil (2011) used intra-coder reliability for her book, based on her dissertation work where there were no other authors. The researcher was unable to identify QCA studies published in english that indicated use of both reliability measures. After some consideration, both inter- and intra-coder reliability measures were used for this study. High intra-coder reliability indicates that the coding is stable and reliable, that the coder

replicates their coding at different points in time, much like someone throwing a dart at a dart board in the first column of Figure 4.2. Both graphs in the first column show consistency and precision in the location of the darts on the board. High inter-coder reliability would help make the case that the coding frame is accurate, that someone of a similar knowledge background would interpret the data the same way, as seen in the first row of graphs in Figure 4.2. Ideally, a coding frame should be both accurate and precise, thus both reliability measures were determined to be useful for assessing this portion of the study.

With reliability measures, identical replication of a qualitative study is often not possible given the nature of qualitative research, but two coders with similar backgrounds and knowledge of the research questions should result in similar conclusions (Steinke 2004). With this in mind, a second coder was selected for the inter-coder reliability check that had a similar background to the researcher (earth science and meteorology). To ensure a random sample of 15% (n=58) for recoding was selected, a bash script was written to select the files to be included in the sample. The inter-coder agreement between myself and the second coder was 98.3% for the first dimension with conditional agreements of 96.5% and 96.4% for the second and third dimensions respectively (Table 4.3). The conditional agreement was determined through eliminating from the calculation any articles that myself and the second corder coded differently in the previous dimension. For example, if we coded an article differently in the first dimension, this article was not counted in the calculations for agreement in the second or third dimensions. For the intra-coder reliability, once the coding frame was finalized, I completed a second coding pass on a different random sample of 15% of the newspaper articles after more than two weeks had elapsed. The intra-coder reliability between the two coding passes was 100% for the first

dimension, 96.6% for the second dimension, and a conditional 100% for the third dimension of the coding frame. The high level of agreement between myself and the secondary coder, as well as between the two passes I coded myself, lead to the conclusion that the coding frame developed is both accurate and precise. It is worth noting that the percent agreement might be less meaningful for the second and third dimension given the small number of articles coded under some of the codes in those levels.

**Stakeholder Interviews**

The 2017 Framework Development Team was composed of the individuals representing federal, state, and local governments, non-governmental organizations (NGOs), industry, and academia that have a vested interest in coastal restoration in southern Louisiana. Of the 58 individuals credited as being members of the team, 10 represented federal government agencies (17.2%), 10 represented state government agencies (17.2%), 8 represented local/parish governments (13.8%), 12 represented NGOs (20.7%), 13 represented industry or industry advocacy groups (22.4%), and 5 represented academia (8.6%) (see Figure 4.3). The industry group included representatives from the oil and gas, chemical, fishing, and shipping industries, all of which have an interest in maintaining Louisiana's working coast. There was also some overlap with this group of individuals and those who served on the Framework Development Team for the 2012 Coastal Master Plan, with 46.6% of the 2017 Plan Framework Development Team having served on the team for the previous 2012 Plan as well.

As the 2017 Coastal Master Plan only listed the names of those on the Framework Development Team, an internet search was conducted on each person's name to locate an

appropriate email address for them. Contact information for 84.5% of the team was found this way. Of the nine members where an email address could not be found online, seven had phone numbers available while for the remaining two no contact information could be found online. An introductory and explanatory email/phone call was sent/made to each member (N=56) inviting them to participate in this research. Twenty-one members responded with twenty indicating interest in participating and one saying they were not interested. Of the twenty who were interested, eighteen agreed to schedule interviews. Sixteen semi-structured telephone interviews were conducted during October and November of 2018. The two other potential participants who had agreed to be interviewed were unexpectedly unavailable during the scheduled interview time and were unable or unwilling to reschedule. All interviews were audio recorded with the permission of the participants and then were transcribed, cross-checked, and anonymized to protect participants' identities.

Conducting interviews of participants is a useful data collection method if you are trying to explore different perceptions, meanings, or opinions within a group. As a data collection method, interviewing can provide valuable insights that may not be available through solely quantitative survey data (Valentine 2005; Dunn 2010). A potential problem with interviewing can be the unwillingness of participants to speak freely with you the researcher about sensitive topics, which can be heightened if you are a stranger to the participant, for example, because of concerns about confidentiality or because the researcher does not belong to the cultural or gendered group where such topics of discussion would be appropriate. Telephone interviews were conducted instead of in-person interviews as it would be easier in terms of both time and cost for both participant and interviewer (Stewart and Cash Jr. 2008). Conducting telephone

interviews also gave potential participants more agency in rescheduling interviews to more convenient times if needed, such as outside of regular work hours, or to choose not to participate at all. Telephone interviews eliminated the implied pressure on potential participants that since the researcher had traveled from another state solely to speak with them that they "should" agree to participate.

All interviews conducted were audio recorded, with participant permission. Audio recording enhanced data collection in two ways, the first through providing a comprehensive record of the informed consent process for each participant as well as the conversation that followed (Whyte 1982). The second was through additional anonymity for participants after the audio file for their interview was transcribed and de-identified. After each audio file was transcribed, it and the back-up recording file were subsequently securely deleted from the researcher's computer, leaving the only record of the conversation as the anonymized transcription.

Semi-structured interviews were conducted using an interview guide developed prior to the beginning of data collection (see Appendix A). The interview guide is composed of primary and probing questions, with additional probes composed as needed during each interview (Stewart and Cash Jr. 2008). While conducting the interviews a more of an empathetic interviewing style was used, as described in Oakley (2018) and Seidman (2019), to encourage participants to share their thoughts and experiences as they relate to the questions in the interview guide. A key component of this interviewing style is to make the researcher less intimidating to participants through being friendly and engaging in small talk to help participants feel more at ease with the researcher before beginning the interview instead of appearing

detached or distant as a way of maintaining a professional boundary. In accordance with another component of this interviewing style, at the beginning of each interview it was stressed to the participant that the interviewer was not looking for some "correct" answer, that instead they were interested in their perceptions of the implementation process, positive and negative. After the completion of the data collection, all the anonymized transcripts were inputted into a qualitative data analysis software program, NVivo 12, for further analysis.

Interview data was then analyzed using the qualitative method of thematic analysis. Thematic analysis provides social science researchers with a systematic and methodical way for identifying, analyzing, and reporting on patterns, or themes, within a textual data set (Attride-Stirling 2001; Braun and Clarke 2006). It provides the researcher with explanatory power beyond just their intuition (Attride-Stirling 2001). As this is an exploratory study of the perceptions on the implementation of the master planning process by publicly identified stakeholders participating in that process, I was interested in the general patterns that existed within the interview data around uncertainty, adaptive management, and stakeholder scientific literacy. Adaptive management is a well-developed framework in the peer-reviewed literature but also one that has often resulted in implementation failure when translated into practice. Through employing thematic analysis, an assessment can be made about the fidelity of Louisiana's efforts to implement adaptive management to the established framework in the literature. Qualitative methods are a good choice for exploratory research (Attride-Stirling 2001; Bazeley 2013), and thematic analysis in particular is useful as the results are typically accessible to the general public and for informing policy development in this sphere (Braun and Clarke 2006), which would be beneficial in the dissemination of this work.

Thematic analysis is differentiated from other methods such as grounded theory and discourse analysis in that it does not require the deep theoretical or technological grounding in methodical approach of both the latter methods (Braun and Clarke 2006). This also provides the advantage of making thematic analysis a much more approachable method for qualitative researchers (Braun and Clarke 2006). The thematic maps the researcher produces during analysis also provide succinct visualizations of the connections discovered and help the audience better understand the analytic narrative the researcher is elucidating (Attride-Stirling 2001; Braun and Clarke 2006). Besides ease of use, this method also provides flexibility, allowing for it to be applied either as a realist method, that is reporting the experiences, meanings, and reality of participants, or as a constructionist method, exploring how events, meanings, and experiences are interpreted through the different discourses influencing society (Braun and Clarke 2006).

There are some potential issues to keep in mind while using thematic analysis. It is not perceived by some in the qualitative research community as a sophisticated or "branded" form of analysis such as grounded theory, meaning that conclusions developed using thematic analysis may not be viewed as valid since the method is viewed as simplistic (Attride-Stirling 2001; Braun and Clarke 2006). Braun and Clarke (2006) state that the choice of method of analysis should be driven by both the research question(s) being studied and the relevant theoretical assumptions of the researcher, not "methodolatry" where the researcher is committed to a particular qualitative method regardless of the research question. Another thing to note, if a thematic analysis is not linked to an existing theoretical framework it will have limited interpretive power beyond just description (Braun and Clarke 2006). This method has much utility, but if the research questions are looking at choice of language by research participants,

thematic analysis is not a good method for investigating language usage as compared to methods like quantitative content analysis or discourse analysis (Braun and Clarke 2006).

## Tables and Figures

| News Source | Search Term | Number of Articles |
|---|---|---|
| The Times-Picayune | Coastal master plan | 121 |
| | Coastal erosion | 181 |
| | Coastal restoration | 604 |
| | Sediment diversion | 45 |
| | Adaptive management | 7 |
| The Advocate - Baton Rouge | Coastal master plan | 97 |
| | Coastal erosion | 179 |
| | Coastal restoration | 688 |
| | Sediment diversion | 41 |
| | Adaptive management | 12 |
| The Advocate - New Orleans | Coastal master plan | 73 |
| | Coastal erosion | 201 |
| | Coastal restoration | 401 |
| | Sediment diversion | 33 |
| | Adaptive management | 2 |
| The Advocate - Lafayette/ Acadiana | Coastal master plan | 11 |
| | Coastal erosion | 27 |
| | Coastal restoration | 98 |
| | Sediment diversion | 2 |
| | Adaptive management | 1 |
| The Lens | Coastal master plan | 110 |
| | Coastal erosion | 87 |
| | Coastal restoration | 226 |
| | Sediment diversion | 58 |
| | Adaptive management | 1 |
| | total: | 3306 |

Table 4.1: Number of articles per search term for each news source used in this study. Also shown is the total number of articles identified for potential inclusion in the corpus.

| **Quantitative Content Analysis** | **Qualitative Content Analysis (QCA)** |
|---|---|
| Focus on manifest meaning | Focus on latent meaning |
| Little context needed | Much context needed |
| Strict handling of reliability | Variable handling of reliability |
| Reliability checks more important than validity checks | Validity checks just as important as reliability checks |
| At least partly concept-driven | At least partly data-driven |
| Fewer inferences to context, author, recipients | More inferences to context, author, recipients |
| Strict sequence of steps | More variability in carrying out the steps |

Table 4.2: Table summarizing the differences between quantitative and qualitative content analysis (Schreier 2012).

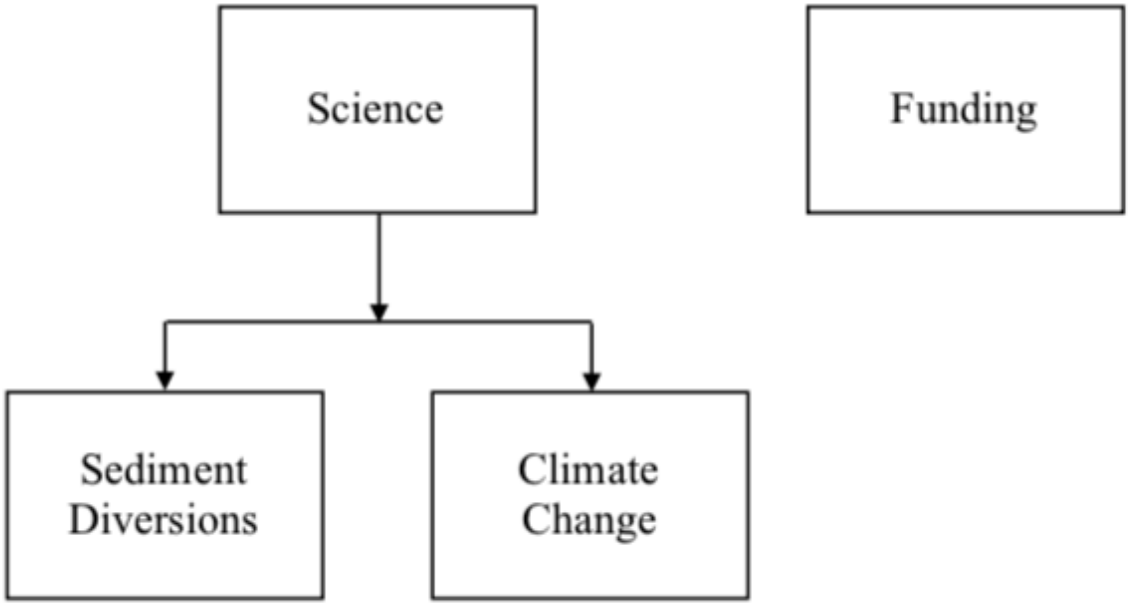


Figure 4.1: The conceptually developed categories and sub-categories of the coding frame.

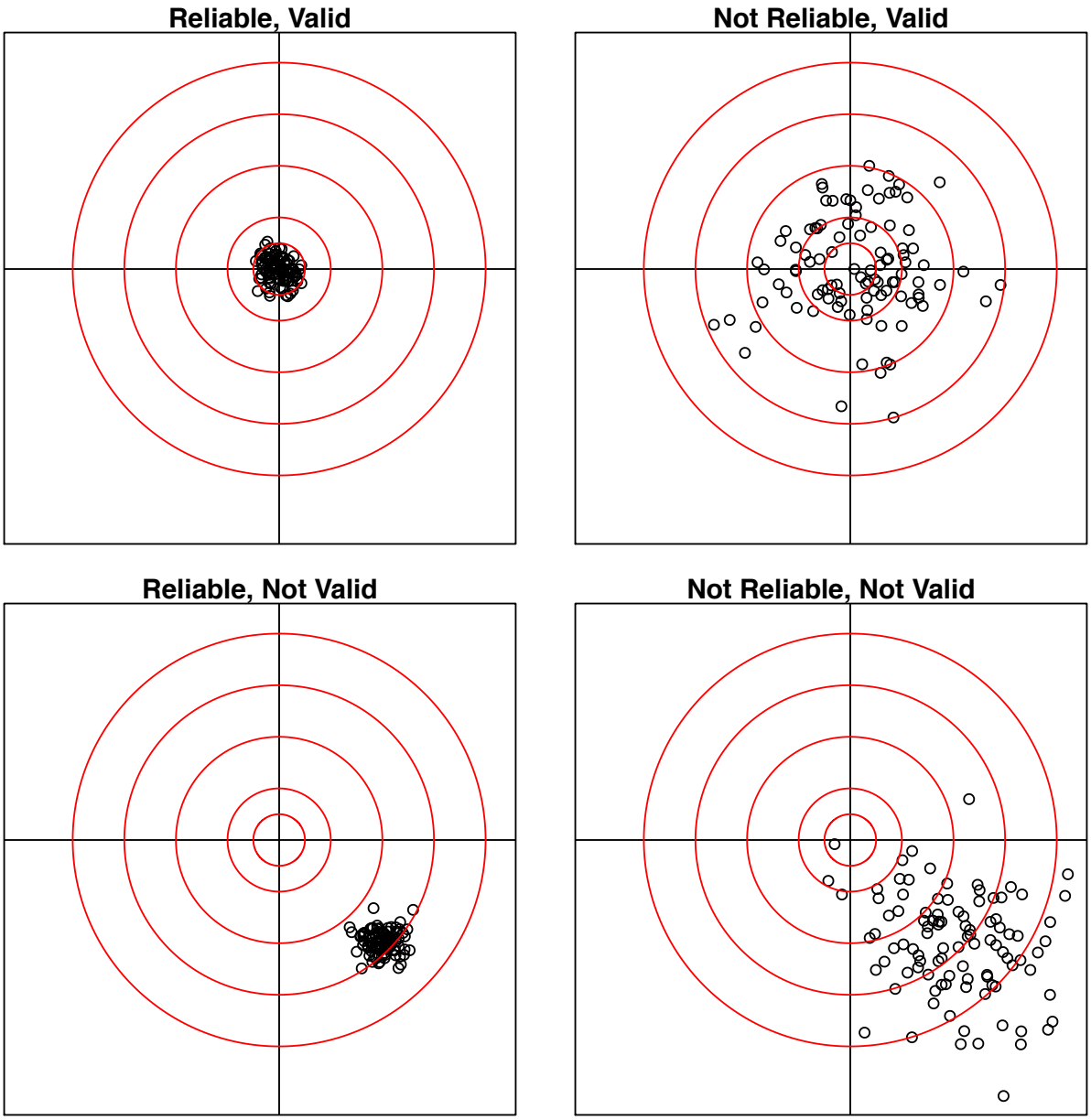


Figure 4.2: A two-by-two matrix demonstrating the different combinations of reliability/precision and validity/accuracy. The left column represents high reliability/precision, the right column low reliability/precision. The top row shows high validity/accuracy while the bottom row shows low validity/accuracy.

| Coder | 1st Dimension Agreement | Conditional 2nd Dimension Agreement | Conditional 3rd Dimension Agreement |
|---|---|---|---|
| Main Coder | 100% | 96.6% | 100% |
| Secondary Coder | 98.3% | 96.5% | 96.4% |

Table 4.3: Table showing the intra-coder (main coder) reliability and the inter-coder (secondary coder) reliability.

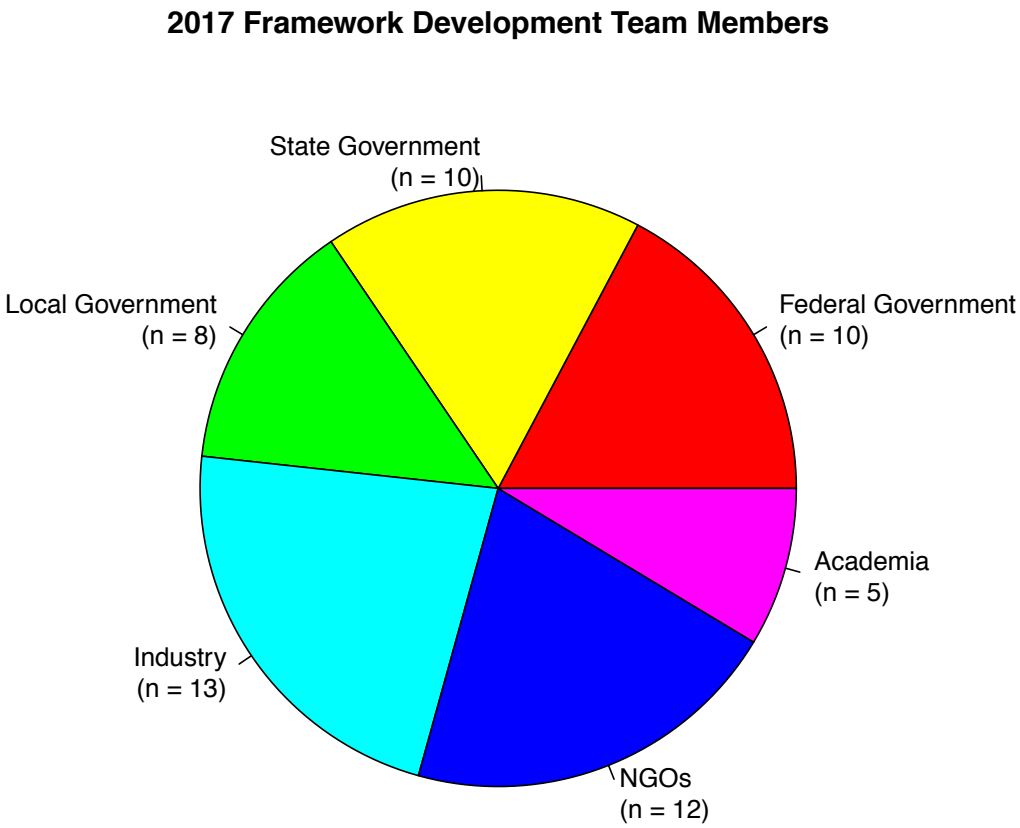


Figure 4.3: The different stakeholder groups represented on the 2017 Coastal Master Plan Framework Development Team.

# Chapter 5: Document Analysis

The purpose of this analysis was to explore the public discourses around major areas of uncertainty and the coastal master plan. This includes determining what differences exist in coverage of science and funding related issues, including examining the coverage around two controversial science topics (climate change and sediment diversions) as well as determining, based on frequency of coverage, what were considered the main issues concerning the financial aspects of the master plan. The qualitative content analysis of the newspaper article corpus included 385 articles from five local newspapers in the southern Louisiana, *The Times-Picayune, The Advocate, The New Orleans Advocate, The Acadiana Advocate,* and *The Lens*. The breakdown of the number of articles that focused on the science of or financial aspects and the coastal master planning process per newspaper during the time period of 1-1-2012 to 12-31-2016 is shown in Table 5.1. The newspapers with the highest total number of articles, *The Times-Picayune* and *The Advocate,* were the largest two newspapers in the state during the study period in terms of readership and are located in the largest two cities in the state, New Orleans and Baton Rouge respectively. Both cities are expected to be physically and financially affected by the success or failure of the efforts to restore the coast. *The Lens*, with the fourth highest number of articles, is an online periodical that focuses on public policy issues and investigative journalism in New Orleans and the Gulf Coast. The coastal master planning process is a major environmental public policy undertaking by the state of Louisiana so it falls under the scope of the periodical.

The two areas of uncertainty around the coastal master plan, science and finances, became the two main categories in the first dimension of the coding frame (see Figure 5.1). The conceptual code of ‘funding’ from Figure 4.1 was renamed ‘financial’ to better encompass all the

facets of this topic in the corpus. Several descriptive codes where also defined in this analysis, including the newspaper in which the article was published, the month and year of publication, and the author of the article. These descriptive codes will be used to add further context to the codes composing the coding frame. The full coding frame is presented in Table 5.2. The coding frame with definitions for each code is located in Appendix B for quick reference. The next four sections will discuss the first dimension of the coding frame, followed by the second and third dimensions of the frame under the "science" and "financial" codes respectively, with discussion to close.

**First Dimension**

Figure 5.1 shows the both the yearly and individual newspaper coverage of the science and financial aspects of the Coastal Master Plan and the coastal master planning process in general. Over the course of the time period (2012-2016), there is an increase each year in the number of articles published, with a small decrease occurring in 2016 that returned coverage to roughly the same level as 2014. As will be discussed later in this chapter, 2015 was an extraordinary year for the state of Louisiana as the fines and penalties incurred by BP and its affiliates were agreed upon and this resulted in an increase in newspaper coverage as these funds were and remain a major source of funding for the state's coastal master plan. As expected, the two major newspapers, *The Advocate* and *The Times-Picayune*, provided the bulk of the coverage of the areas on interest. At the start of the time period only three of the five newspapers were functioning, *The Times-Picayune, The Advocate*, and *The Lens. The New Orleans Advocate* launched in September of 2012 in response to the decision by owners of *The Times-Picayune* to

reduce its print edition from daily to only 3 days a week (Meyers 2012). *The Acadiana Advocate* launched in December of 2013 to fill a perceived gap in local news coverage in the Acadiana region of the state. Given that the focus of *The Lens* is to "provide the information and analysis necessary to advocate for more accountable and just governance" ("In-Depth News and Investigations for New Orleans"), it was surprising to see that the entity did not have a similar number of articles as *The Advocate* and *The Times-Picayune.*

Of the 385 articles in the corpus, 59% (n = 227) dealt with financial elements of the coastal master plan while 41% (n = 158) dealt with the science. In order for an article to be coded as "financial," the majority of the article needed to discuss the financial aspects of the master plan, for example where money for the plan may come from, what the money was going to be used for, or politicians that were attempting to use master plan funds for non-coastal restoration purposes. Likewise, for an article to be coded as "science" in the first dimension, the majority of the article needed to cover some element of the science being used in or affecting the coastal master plan, such as peer-reviewed papers/reports being covered by a reporter or debates about how new scientific findings will affect the plan. Figure 5.2 shows the frequency of these two main codes by both year and newspaper, with "financial" articles occurring at higher frequency every year except 2014 and in all the papers but one. The 2012 Coastal Master Plan estimated the combined price of the coastal restoration projects listed within it to be $50 billion dollars, which was money the state did not have in 2012. During the study period some sources of funding did become available to the state through fines assessed by the federal government to BP and Transocean as penalties for their actions resulting in the 2010 Deepwater Horizon explosion and oil spill in the Gulf of Mexico, but altogether this amounted to roughly $8-10 billion in funding,

still far short of the $50 billion needed. 2014 was an important year for the coastal master plan regarding the science the plan was based on, leading to the highest level of coverage in the study period. That year a public debate about the science of the proposed the sediment diversions, a major component of the 2012 plan, erupted into the public discourse as local fishermen and oystermen argued that the science behind the sediment diversions was not as "proven" as had been indicated and thus the proposed diversions were a far riskier coastal restoration technique than other, more proven, methods. This greater focus on financial issues related to the Master Plan instead of the scientific questions suggests that financial and/or political uncertainty connected to the plan is a bigger concern within the state than the scientific uncertainties. Both areas will be further discussed later in this chapter.

As mentioned previously in Chapter 4, duplicates from within the same paper were eliminated from the corpus. The decision was made not to eliminate duplicate articles from the corpus that occurred *across* newspapers as the newspapers all targeted different regions of the southern portion of the state and potentially different audiences. Approximately 32% of the corpus articles were reprinted in more than one newspaper. This percentage was true for articles coded in either of the first dimension codes: 32% of articles coded as "financial" and 32% of articles coded as "science" were duplicates. Figure 5.3 depicts the number of articles for each paper that were classified as duplicates. *The New Orleans Advocate* and *The Acadiana Advocate* are both owned be the same company as *The Advocate*, so articles published in *The Advocate* were often duplicated in the other two papers. 26 of the 29 articles (90%) published in *The Acadiana Advocate* were copies of articles originally published in *The Advocate*, often published on the same day as the original article or day or two after. Likewise, 43 of the 54 articles (80%)

from *The New Orleans Advocate* were also duplicated from *The Advocate* articles. Only 8 of the articles (17%) from *The Lens* were duplicates, appearing in *The Advocate* and its affiliated papers roughly five days after original publication. The only newspaper without duplicates was *The Time-Picayune*, a paper viewed as a competitor of *The Advocate* and *The New Orleans Advocate*.

**Category: Financial**

Table 5.3 shows the part of the coding frame sub-coded under the "financial" main code. Five second dimension codes were developed under the "financial" code, including "allocation of money," "project costs," "political maneuvering," "sources of funding," and "miscellaneous" for any article that did not fit under one of the previous four codes. Two of the second dimension codes, "allocation of money" and "project costs," were straightforward with uncertainty not being a focus within the code. Both of these codes were describing the relatively certain and concrete plans the state of Louisiana and the Coastal Protection and Restoration Authority (CPRA) had for coastal restoration funds. For an article to be coded as "allocation of money," the article had to discuss how money that the state had access to, or would have access to in the near future, would be used, such as annual project plan budgets that would be submitted to the state legislature for approval. Likewise, for an article to be coded as "project costs" the main focus of the article needed to be covering the anticipated or forecasted costs of projects, or amount of money being requested for x or y project. Unlike with "allocation of money," Louisiana and CPRA did not have access to the money required for these projects.

Uncertainty was a main focal point for the two remaining second dimension codes listed in table 5.3, "political maneuvering" and "sources of funding." Articles coded as "political

maneuvering" spoke to either attempts or successes in using money assigned for coastal restoration and/or the coastal master plan for something else. Also included under this code were articles containing general warnings from the author against political maneuvering. "Sources of funding" encompassed articles that covers how the state planned to fund the coastal master plan during the study period, including new ideas for generating funds or potential ideas that may have been tried but have not been proven at scale. These two sub-codes combined composed the majority of the articles coded under "financial" at 65.2%. Figure 5.4 shows the relationship between the two sub-codes and how their frequency changed both over the study period and by newspaper. "Sources of funding" was a bigger focus in the early portion of the study period, from 2012 through 2014, with "political maneuvering" increasingly markedly in 2015 and remaining the bigger focus in 2016 as the federal government and the state of Louisiana agreed to a settlement with BP regarding the 2010 Deepwater Horizon explosion and oil spill in July of 2015. Across the newspapers, *The Advocate* and its sister papers focused more heavily on political maneuvering while *The Times-Picayune* gave more attention to the sources of funding for the coastal master plan. The geography and history of the two cities of these papers, Baton Rogue and New Orleans respectively, likely explains this difference in coverage. Baton Rogue is the state capital of Louisiana, and as will be discussed further in the following paragraphs, the major concern of many authors of articles coded as "political maneuvering" was that the state legislators not repeat the state's checkered history with large windfalls and misuse the funds for anything besides coastal restoration. New Orleans, comparatively, has a history with trying to fund large projects that are beyond the budgets of the city or the state through the city's on-going experiences with Hurricane Katrina recovery. It makes some modicum of sense that while

reporters and others in Bator Rouge were more focused on potential political malfeasance with any coastal restoration funds, those in New Orleans would be more focused on how exactly this large state restoration project was going to be funded given their own experiences in that arena.

The concerns about political malfeasance among the authors of many of the articles coded as "political maneuvering" was not unfounded as there were attempts at all levels of government, federal, state, and parish, and even a few successes. To explore the uncertainty in this sphere further, the second dimension "political maneuvering" code was further sub-coded into seven third dimension categories, as seen in Table 5.3. The level of government, federal, state, or local, that the article was focused on is listed as the first part of the sub-code while the general topic of the article, warning, attempt, success, is detailed by the second component of the sub-code. "Warning" covers articles that generally speak to how reallocating any funds received for coastal restoration would be harmful to the state's long-term goals. At the state level this code also covers bills that closed loop-holes that would have potentially allowed coastal restoration money to be used for other purposes. "Attempt" included articles that discussed actual attempts at a level of government to reallocate restoration money for other than it was originally agreed to, such as through proposed bills, budget proposals, or, at the state level, attempts to get the Army Corps of Engineers to forgive the state's matching contribution for projects. "Success" would be articles that discuss successful efforts to use coastal restoration money for other purposes than it was originally intended or agreed to, for example using BP oil spill settlement money for non-coastal restoration or recovery purposes as well as a governmental entity not funding a bill passed over a decade ago.

As mentioned previously, the state of Louisiana did not have access to the $50 billion in funding the Coastal Master Plan required during the study period so securing funding for the master plan was a major area of uncertainty. The "sources of funding" second dimension code was further sub-coded into five third dimension codes, "Deepwater Horizon - Certain," "Deepwater Horizon - Uncertain," "certain," "uncertain," and "against," shown in table 5.3. The RESTORE Act, federal legislation passed in 2012 that allocated financial penalties from the Clean Water Act, did not have any real funds to disburse until January of 2013 when Transocean and BP accepted a plea deal. This deal provided RESTORE with roughly $800 million dollars so articles discussing the RESTORE Act or prior to January of 2013 or potential fines from BP were coded as "Deepwater Horizon - uncertain" as there was no guarantee of money. On July 2, 2015, BP and the federal government announced a $18.7 billion settlement of the multiple lawsuits filed by the federal government and five Gulf Coast states, Alabama, Florida, Louisiana, Mississippi, and Texas, so articles from this date forward covering the money coming from fines and/or the settlement were coded "Deepwater Horizon - certain." Articles published between January 2013 and July 2015 were coded depending on the context of the article, if the article was solely referring to the potential fines or penalties Louisiana was expecting to receive then it was coded "Deepwater Horizon - uncertain," if it referred instead to plans for how the Transocean fines received through the RESTORE Act would be allocated then it was "Deepwater Horizon - certain." For the remaining 61.8% of the articles discussing sources of funding that did not deal with the Deepwater Horizon oil spill, the sub-codes of "certain," "uncertain," and "against" were used. "Certain" covered articles discussing funds the state had access to, articles coded as "uncertain" covered potential funds that the state did not have access to or access was in doubt.

Also included under "uncertain" were the new ideas being suggested for raising funds for coastal restoration. The last sub-code, "against," was for articles where the main purpose of the article was to argue against a particular source of funding.

**Category: Science**

The science portion of the coding frame is summarized in Table 5.4. As with the "financial" code, the "science" code was also sub-coded into five second dimension codes, the two conceptual codes discussed in Chapter 4, "climate change/sea level rise" and "sediment diversions," and three data-driven codes, "adaptive management," "general coastal restoration," and "miscellaneous." For an article to be coded as either "adaptive management," "climate change/sea level rise," or "sediment diversions" it must focus on that topic and the master plan, typically by reporting on recently published peer-reviewed papers or reports or local debates about the scientific topic. The code "general coastal restoration" captured those articles that discussed the science of coastal restoration in general terms. These articles did not specify any particular topic related to coastal restoration, for example canal backfilling, limnology, traditional ecological knowledge, etc. The last code, "miscellaneous" was used for those articles that covered science topics that only appeared a few times in the corpus. Even though "adaptive management" represents only 0.6% of the articles in the "science" category, it was not subsumed under the "miscellaneous" code as this is the method of dealing with uncertainty selected by the Coastal Protection and Restoration Authority.

As with "financial" main category, uncertainty was likewise central to the discourse in the "science" articles. The two most coded categories shown in Table 5.4, "sediment diversions"

with 58.9% of "science" articles and "climate change/sea level rise" with 13.3%, each dealt with a topic where scientific uncertainty in this area will have an impact on the implementation of the coastal master plan. These two sub-codes combined composed the majority of the articles coded under "science" at 72.2%. Sediment diversions of the scale proposed in the 2012 plan have never been built or operated before (Turner 2009; Wells et al. 2014a; Wells et al. 2014b; Wells et al. 2015a), leading to much uncertainty as the state begins the process of designing and planning these projects. With climate change, the uncertainty involves the rate at which sea level will rise along the Gulf Coast and how that will affect the location, construction, and/or operation of the various projects in the master plan. Figure 5.5 shows the relationship between these two sub-codes and how their frequency changed both over the study period and by newspaper. For every year and each newspaper included in the study, "sediment diversions" was the most coded science topic. Coverage on this topic is consistent through the study period with a spike occurring in 2014 that will de discussed in further detail later. *The Advocate, The Times-Picayune,* and *The Lens* have roughly the same number of articles on sediment diversions as compared to the other two papers with fewer articles. Similar to sediment diversion coverage, the number of articles coded as "climate change/sea level rise" was also fairly consistent during the study period, though roughly one order of magnitude lower than "sediment diversions," with the exception of 2016 when there was an increase in "climate change/sea level rise" articles. Also similar to the "sediment diversions" coverage, *The Advocate, The Times-Picayune,* and *The Lens* have approximately the same number of "climate change/sea level rise" articles during the study period with the other two papers producing fewer.

To further explore the uncertainty in the discourse, both "sediment diversions" and "climate change/sea level rise" were further sub-coded into six and four third dimension codes respectively, shown in table 5.4. "Research" was the most commonly used third dimension category under "climate change/sea level" with 52.4%. These articles focused on peer-reviewed papers, government reports or the like that had been recently published discussing climate change and/or sea-level rise for the planet and the Gulf Coast specifically. While "2017 Plan Revision" was the second most used code with 33.3% of climate change articles, it appeared only during the latter part of the study period as public, and government, focus began shifting to the revisions needed for the 2017 Coastal Master Plan. Many of the "research" articles also appeared during the latter part of the study period, leading to a comparable number of "climate change/sea level rise" articles to "sediment diversion" articles in 2016 (Figure 5.5). "Observation" focused on articles discussing how climate change or sea level rise is real due to what was being observed along the coast by those that worked on or used the coastal wetlands for recreation. The last third dimension code under "climate change/sea-level rise," "conflict," covered articles where the majority of the article discussed public disagreement over the amount of sea level rise that southern Louisiana should expect in the coming decades.

Within the "sediment diversions" code, "conflict" was the most commonly used sub-code and included articles where the majority of the piece discussed some facet of the conflict around sediment diversions, including articles that are explicitly 'for' or 'against' the diversions as well as articles that discuss the conflict generally. A related sub-code was "problems/uncertainty," which included articles discussing of the general uncertainty around the effectiveness of the diversions but did not take a position or side in the conflict, those articles that covered the

uncertainty as to whether or not diversions will actually be authorized to be built, and/or articles covering the process of authorizing planning processes/construction/etc. Two other third dimension codes that were closely related were "research" and "research-beginning." "Research" encompassed the discussions of peer-reviewed papers or reports and the reports published by the different expert panels formed to the study sediment diversions. "Research-beginning" focused on the beginning stages of the research process, the studies that were planned to investigate some element of the proposed diversions but had not yet commenced at the time of the article publication. The remaining two codes, "natural diversion" and "built diversion," comprised articles focusing on the natural crevasse, nicknamed the Mardi Gras Pass, in the Bohemia Spillway and the West Bay Diversion in Plaquemines Parish respectively.

## Discussion

Based on this analysis, topics with uncertainty were a main component of the public discourse around the coastal master plan during the study period with 65.2% of "financial" articles and 72.2% of "science" articles engaging in coverage. This included the four second dimension codes that would have an impact on the implementation of the 2012 plan: "political maneuvering," "sources of funding," "climate change/sea level rise," and "sediment diversions."

Political maneuvering has a direct effect on implementation in that if policymakers misuse funds, it is unlikely the public or the other levels of government will allocate more funds to the same purpose. In the case of the 2012 Coastal Master Plan, this study shows that there is weak public and/or press trust in the politicians at the state level as 60.5% of "political maneuvering" articles were providing warnings to or publicizing attempts by state level

politicians to use coastal restoration money for other purposes. These attempts include then Governor Bobby Jindal's attempt to use coastal restoration funds to elevate Louisiana Highway 1, the major roadway serving oil refineries in Port Fourchon, due to a lack of available funds in the state's transportation budget, attempts by state politicians to tack on amendments to bills in 2012 (House Bill 812) and to pass three Senate Bills (182, 214, 315) and four House Bills (477, 504, 509, 512) in 2016 that would have provided loopholes allowing coastal restoration funds to be used for general state operation purposes, as well as an effort by state officials requesting the state's cost-share for new federal levees built after Hurricane Katrina be forgiven, roughly estimated as $3 billion over the next 30 years. State officials indicated that if the cost-share was forgiven they would use the funds for coastal restoration, but given the other attempts during the study period, it is reasonable that the federal government would have doubts. It should be noted though, at the time it did not appear Louisiana had the funds for the cost-share. The state would need to use money expected from the Gulf of Mexico Energy Security Act (GOMESA) to pay its portion, money that the state had already pre-allocated, which may further contribute to a perception at the federal level that the state government does not manage its finances properly.

All together, the same concerns raised during the aftermath of Hurricanes Katrina and Rita about misappropriation of funds were again raised at the state level during the study period. The state's history of financial mismanagement appeared to continue as there were some successes in siphoning funds for coastal restoration. Given this history, it was not surprising that there were attempts at mismanagement, and it is a surprising and hopeful sign that there were only two successes at the state level. Though the previously mentioned attempts were not successful, the Jindal administration did succeed in using tobacco settlement funds allocated by a

constitutional amendment for coastal restoration for regular state budget operations and current Governor John Bel Edward's administration succeeded in 2016 in using BP oil spill funds to help fill the budget deficit left by the Jindal administration. It should also be noted that the state did not have access to large sums of money during the study period, the BP settlement was announced close to the end of the study period so only a small portion of the expected funds were actually available to be used and funds from GOMESA would not begin flowing into state coffers until 2017. This lack of access to funds may have prevented additional attempts and/or success at misappropriation.

Financial mismanagement also trickled down to the parish level. The individual parishes were not a major focus of the newspaper articles, but once the BP oil spill settlement was announced there was some focus on what parish officials planned to do with these funds. Given Louisiana's home rule doctrine (Engstrom 1976; Dendy 1977), parish officials are not bound by state-level dictates on how to use the settlement money. Jefferson Parish officials succeeded in using $20 million of the $35 million dollars they received from the BP settlement for non-restoration purposes, such as the parish general fund. The public, according to the newspaper articles, appeared to want the entirety of $35 million to be used for restoration or structural protection in the parish, as mentioned in the two articles coded "Parish - Attempt." The decision made by Jefferson Parish to allocate their money in this manner was compared to the perceived 'smarter' decision made by the City of New Orleans and Mayor Mitch Landrieu to allocate all of the money the city received in its portion of the BP settlement for restoration purposes as the city's contribution towards securing matching funds from the federal government.

Political maneuvering extended to the federal level as well, with 27.6% of articles covering attempts by Congress or President Obama to reapportion federal funding to the state. While not explicitly said, there are echoes of the political gamesmanship that occurred in the aftermath of Hurricanes Katrina and Rita in 2005 when the then-governor of Louisiana, Kathleen Blanco - Democrat, and then-president, George W. Bush - Republican, were of different political parties. For the majority of the study period, 2012-2015, Republican Bobby Jindal was governor of the state while Democrat Barack Obama was in the White House. During this period federal attempts included the sequester in 2013 holding back needed funds to start restoration projects, a bill sponsored by the Senate Appropriations Committee attempting to redirect $10.2 million from the Gulf Coast Restoration Trust set up through the RESTORE Act, an attempt during the fine tuning of details of the RESTORE Act to redirect money from the ecosystem restoration 'pot' to economic recovery purposes, a legislative attempt in 2015 by Senate Democrats to repeal GOMESA, and President Obama's proposed 2016 federal budget that redistributed Louisiana's expected share of GOMESA funds. When asked about his budget proposal, President Obama indicated that "he would like to see Louisiana receive its fair share of revenue, but [he] has concerns about guaranteeing that individual states will use the money for its intended environmental purposes," (Times-Picayune Editorial 2015). Given the previously mentioned attempts to misdirect restoration funds by the state, this concern by the president appeared to have merit.

Due to term limits, Jindal was unable to run for governor a third time in November 2015, leading to the election of Democrat John Bel Edwards as the new governor for the remainder of the study period. After Edwards took office, federal attempts at political maneuvering markedly

decreased, strengthening the argument that federal coastal restoration funding was being used as a political pawn between the Obama and Jindal administrations during the study period. The sole attempt in 2016 being a repeat of President Obama's GOMESA proposal for the 2017 federal budget. Governor Edwards led a successful letter campaign to the President requesting that the proposed redirection of GOMESA funds not be enacted.

The sole federal success discussed in the newspaper coverage had its roots in the aftermath of the 2005 hurricane season. Congress overrode a veto from President George W. Bush in 2007 to authorize the U.S. Army Corps of Engineers (USACE) to complete 15 coastal restoration projects in Louisiana at a cost of $1.6 billion. While at first this appeared to be a much needed success for coastal restoration advocates, the federal government has yet to vote, as of this writing, to appropriate any funding to allow the Corps of Engineers to follow through on the authorization. In light of this lack of appropriation, this was considered to be a federal success in political maneuvering during the study period, Congress provided the impression with the 2007 USACE authorization that they were ready to act on coastal restoration in Louisiana but have succeed in reallocating the money needed by not holding a vote to appropriate the funds, resulting in the proposed restoration projects not being implemented.

Beyond the uncertainty of whether money allocated for restoration would be spent as such, there was much uncertainty as to how the state was going to raise the $50 billion the 2012 plan was expected to cost. This was reflected in the corpus, with 26.4% of articles coded as "sources of funding" discussing certain sources and 70.9% discussing uncertain sources. During the first half of the study period, the state of Louisiana had roughly $100 million to $110 million per year, $30 million from the state's Coastal Restoration and Protection Trust Fund and $75

million from the Coastal Wetlands, Planning, Protection and Restoration Act (CWPPRA), to use for restoration projects. Forecasting this level of funding per year fifty years into the future, the expected lifetime of the 2012 plan, results in a total expenditure of $5 billion, $45 billion less than the expected amount needed. Three other sources of revenue, unrelated to the Deepwater Horizon disaster, were discussed as well. A one time grant of $92 million was awarded to the state in 2016 to be used for non-structural protection measures, such as the relocation of the Isle de Jean Charles community in Terrebonne Parish and community development measures in support of the master plan. Another source was 2014 agreement between the Louisiana Department of Natural Resources and the USACE on wetland developer fees, allowing for a "in-lieu fee" program to allow developers of projects that damage or destroy wetlands in the state to pay one fee for mitigation to the state instead of separate fees to both the state and the USACE. The USACE also pointed out that most new developers in the region were small outfits so demand for permits eligible for this program would be fairly limited. While helpful, this agreement would likely not greatly contribute to recurring funding streams.

The third source covered was financial contributions of the oil and gas industry to the state, though the overall tenor of the two articles implied much and were slim on specific details. Both articles were letters to the paper, one to *The Baton Rouge Advocate* and one to *The Times-Picayune*, written by Marc Ehrhardt, the executive director of the Grow Louisiana Coalition, an industry group promoting the expansion of the industry in the state. Both spoke glowingly of the oil and gas industry's support for restoration and positioned the industry as the economic cornerstone of the state. The industry was held up as the largest private funder of restoration in the state, though no specific details to support this claim were mentioned. The industry does pay

roughly $1.5 billion in state taxes and fees each year so they do make a regular contribution to the state budget that helps support restoration. At the same time though, the industry continues to push back against new taxes being assessed against them, as shown with the articles coded under "against." Both of these articles were also letters to the paper, *The Baton Rouge Advocate* and *The New Orleans Advocate*, specifically advocating against a proposed coastal wetlands environmental levy that had been suggested as way for the oil and gas industry to help shoulder some of the financial burden of restoration as they had contributed to the coastal erosion problem through dredging thousands of canals in the wetlands. The industry did not have a formalized arrangement with the state or the CPRA to contribute funds towards the 2012 Master Plan during the study period. These were the only articles to advocate against a source of funding in the entire corpus.

The oil and gas industry was also the likely instigator of the previously mentioned state-level political maneuvering attempt to use restoration funds to elevate LA Highway 1 near Port Fourchon. Port Fourchon is a major seaport on the Gulf of Mexico considered to be critical infrastructure as it serves the offshore oil and gas industry and provides roughly 18% of the country's oil supply. LA Highway 1 was highly susceptible to flooding, and when flooded the seaport was unable to operate properly, costing the oil and gas industry. Then-Governor Jindal suggested and supported the idea of using restoration funds for the highway elevation, leading to charges he was setting a dangerous precedent that could allow future funds to likewise be diverted to unfunded infrastructure projects. Given that Jindal has received over a million dollars in campaign contributions from various oil and gas companies, and had previously demonstrated positions on policies that align with the interests of the oil and gas industry to the likely

detriment of the citizens of Louisiana (i.e., his vehement opposition to the lawsuit filled in 2013 by the Southeast Louisiana Flood Protection Authority - East (SLFPAE)) (Schleifstein 2013; Zebrowski and Leach 2014), it is very probable that the industry was using then-Governor Jindal in an attempt to socialize their costs of doing business in a deteriorating physical environment caused by their product and their extractive operations. Overall, given the state's long history of not holding the industry accountable, this political maneuvering attempt among others, and the state's tacit acceptance of the lack of true financial contributions by the industry suggest that the deep structural changes needed in the relationship between the state and the industry for the 2012 master plan to be implemented successfully had not yet occurred during the study period.

The Deepwater Horizon oil spill occurred shortly before the start of the study period in April through September of 2010 and greatly impacted the coastline of Louisiana and the industries that operate there. Consequently, the potential financial compensation for this damage that Louisiana could, and did, receive was a main topic in press coverage with 37.5% of "sources of funding" articles. At the beginning of the study period there was much uncertainty about how much money Louisiana would actually receive, if any, making it difficult to determine what projects were actually possible in the near term for implementation. The financial penalties that BP and its associates had incurred as a result of the spill were due to the federal government, not the state, under the Clean Water Act so there was no guarantee that any money would eventually flow to Louisiana. Also, with the plethora of lawsuits filed against BP and associates it was unclear when the cases would be resolved, either through rulings that were no longer appealable or through settlements, leading to an unclear timeline for when Louisiana could reasonably expect to receive any money from the disaster. These uncertainties were reflected in code

"Deepwater Horizon - uncertain," as the articles coded as such occurred primarily during 2012 and 2013.

A positive first step was made by Congress and the Obama administration with the passage of the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States (RESTORE) Act in June of 2012. This law required 80% of any penalties received by the federal government from the Deepwater Horizon disaster would go to the five Gulf Coast states, Alabama, Florida, Louisiana, Mississippi, and Texas. The passage of this law was a guarantee that Louisiana would receive some compensation for the damage the spill caused, but until settlement(s) were reached the RESTORE Act was essentially an unfunded measure. A determination of how much each state would receive of the 80% allocated was also left undecided for the time being. Louisianians were confident after the passage of the act that the state would receive a windfall from the disaster, but still uncertain as to the time frame.

During the last two years of the study period, legal settlements between BP and its partners, the federal government, and the five affected Gulf Coast states were reached, resulting in certainty at last in the amount and timing of funding Louisiana could expect. The first major settlement came in early 2013 with Transocean, the company that owned the drilling rig that exploded, for about $1 billion, with $800 million to be allocated to the five states through the RESTORE Act. The biggest settlement came in July of 2015 with an agreement announced between the federal government, the five states, and BP to resolve all pending cases for a record renumeration of $18.7 billion. Louisiana received the largest amount of the five states with $6.8 billion to be paid over the next 15 to 18 years. This was the single largest source of funding for the master plan the state secured during the study period, greater than the state's reoccurring

sources of funding, and increased the expected annual financial stream for the plan to $800 million per year until 2032. While this is enough funding to allow the state to move forward on some of the major components of the plan, such as the sediment diversions, the BP windfall is a one-time funding source; Louisiana was not successful in securing large, reoccurring sources of funding, federal or other, during this period.

There was also discussion in the corpus with thirty-nine articles covering of a variety of creative, but uncertain, methods and ideas for how and where the state could bridge the gap to fully fund the plan. Included was a general call that more sources of funding were needed in acknowledgement that the funding gap existed. At the federal level this included members of the Louisiana congressional delegation sponsoring two pieces of unsuccessful legislation, the Offshore Petroleum Expansion Now (OPEN) Act of 2012 and the Fixing America's Inequality with Revenues (FAIR) Act of 2013, that would increase that state's share of revenue from energy production. The state's delegation also made several attempts to direct more funds to the state through attaching funding amendments to other bills thought likely to pass. They did work successfully with state leaders to keep Louisiana's at the time future-share of GOMESA funds intact despite several attempts by the Obama administration to redistribute the funds for other uses.

The USACE was also suggested as a potential funding source for restoration, with state leaders hearkening back to the agency's long history in the state of building large flood control and navigation projects. One idea floated was working with the USACE to change its management of navigation and flood prevention programs operating on the Mississippi River to also benefit state restoration projects, such as the USACE depositing the sediment it dredges

from the river for navigation purposes in nearby marshes that are starved for sediment instead of the current practice of letting it flow in the river to the Gulf of Mexico. Changing the disposal method for dredged sediment would add to the cost of USACE projects, and given the tight margins the Corps operates under this idea seems unlikely to find much traction in Washington, DC. Another suggested avenue for greater funding involvement by the USACE was put forward by Colonel Edward Fleming, a former commander of the USACE, New Orleans District: to use funds from the BP oil spill to leverage more money from the federal government through cost-share agreements on federal Louisiana Coastal Area projects. This idea though is unlikely to be supported by Louisiana state leaders for while Congress voted in 2007 to authorize those projects, it has yet to vote to appropriate any federal money for project construction. Historically, the USACE has been a cooperative funding source and partner for Louisiana, but during the study period it did not appear that relationship would expand to include active restoration work by the USACE.

Other uncertain sources suggested included the state assessing higher taxes on the oil and gas industry or, resurrecting an idea first suggested by then-Governor David Treen in the 1980s, assessing a coastal levy on energy companies operating within the state. Neither of these suggestions appear likely to come to fruition given the current relationship between the industry and the state. There have been some small-scale successes of potential funding sources, such as public-private partnerships to build restoration projects, for example East Orleans Landbridge project east of the City of New Orleans, allowing companies to buy into environmental impact banks to offset effects of wetland construction projects, and selling carbon credits through wetland restoration projects. Each method had yet to be scaled up, such as creating a proper state

market place in Louisiana for carbon credits to be bought and sold, to prove that it could generate a reliable revenue stream for restoration projects. Agencies within the state also took measures to secure restoration funding through the creation of a restoration account by the SLFPA-E for any money awarded to the agency from its 2013 lawsuit against ninety-seven oil and gas companies and a state oil spill mitigation bank created by the passage of Louisiana House Bill 640 in 2016. SLFPA-E lawsuit was dismissed by a federal judge in 2015 due to a levee board not having the legal standing to file such a lawsuit, a ruling that was still in appeals to the US Supreme Court by the end of the study period, but it seemed unlikely that the state would receive any restoration funding from that avenue. Several parishes, Cameron, Jefferson, Plaquemines and St. Bernard, have continued the fight, filing their own lawsuits against oil and gas companies. Those cases were still pending by the end of 2016. The state oil spill mitigation bank is something of a catch-22 for Louisiana, to get funding for coastal restoration there needs to be an oil spill, but the very act of the oil spill could cause more ecological damage than could be restored so it seems unwise for Louisiana to try to gain funding in such a manner.

Despite an apparent willingness by the American public to pay to save Louisiana's coast (Petrolia et al. 2014), Louisiana leaders and politicians have been unable to translate that into dollars from the federal government or other sources, with the exception of a disaster windfall from a massive oil spill. How the state was going to bridge the billions of dollars gap to fully fund the master plan was mired in uncertainty during the study period, despite the positive spin the local press tried put on the situation. With the money the state did have in hand, there was the possibility of financial mismanagement, a valid threat given the state's history and attempts by state politicians and the governor to reallocate restoration funding during the study period.

Louisiana ended the study period much as it had started, with a portion of the funds needed available for restoration projects and no true plan on how secure the remainder.

Equally important to the implementation of the master plan is the science that underpins it. Though financial topics were covered more frequently in the corpus, science is equally important for implementation as the plan relies on an untested restoration structure in region that is, and will continue to be, deeply affected by climate change in the coming decades. To manage the scientific uncertainty involved with the master plan, CPRA decided on adaptive management (CPRA 2012). Adaptive management will be the linch pin for the successful implementation of the master plan given its scale and scope, and surprisingly only one article in the entire corpus focused on this topic. The sole article discusses how an adaptive management plan is needed for the implementation but does not provide a clear definition of what adaptive management actually is, referring to it as more of a learning-by-doing approach that involves monitoring projects and modifying them to obtain better results as needed. This definition corresponds to passive adaptive management (see Figure 2.3). The article also covered the need for funding designated for adaptive management and monitoring throughout the implementation process. At the start of the study period, there was not an actual adaptive management plan for implementing the master plan. The intention was to develop an adaptive management plan by the 2017 master plan update, which CPRA was successful in accomplishing.

"Climate change/sea level rise" was the second highest frequency category under science, and a major driver of uncertainty related to the master plan. 62% of these articles covered climate change research or spoke to the direct observations people were making of the damage to wetlands from rising sea levels, of the marshes disintegrating into open waters and coastal forests

dying from salt water intrusion. Of note given Louisiana's history as a Republican stronghold and the domination of the state government by the oil and gas industry, is the lack of articles describing climate change as a hoax. There was only one article that discussed any conflict around climate change, and that was with the forecasted rate of sea level rise, not with the fact the sea is rising or that the rising is due to climate change. The public was not receiving messaging containing value debates about climate change and was instead hearing information that speaks to the scientific research investigating one of the areas of uncertainty in the coastal master plan. Unlike with "sediment diversions," slightly more than half the "climate change/sea level rise" articles cited peer-reviewed literature or agency reports as evidence of the problems that climate change will cause in Louisiana, specifically the rate of sea level rise along the coast in the coming decades. The peer-reviewed studies and reports covered how climate change is and will cause an increase in the number of days per year with temperatures greater than 95°F, stronger tropical cyclones, and higher tides in Louisiana. The higher tides were already being felt along the coast as some roads, such as the previously mentioned LA Highway 1 to Port Fourchon, were flooding during high tides as well as causing significant land loss for the Native American communities of Grand Bayou Village, Grand Caillou/Dulac, Isle de Jean Charles, and Pointe-au-Chien.

The studies also raised some important questions regarding master plan restoration projects. Given the limited sources of funding available to the state, it is important that projects built in the near future do not end up submerged and unusable by the rising sea levels of the slightly more distant future. That raised the question of whether CPRA should extend the planning horizon to a period longer than the current fifty years given the forecasts of climate

models for 2100 in order for the master plan to "keep up" with the rising waters of the Gulf of Mexico, a question that has no easy answers from socio-political standpoint. Additionally, the sea level is not rising in a uniform fashion across the coast due to differing rates of subsidence from oil and gas extraction activities and the compaction of deltaic soils. Climate change may have brought one benefit to the state, warming the waters of the Mississippi River in the deltaic complex enough that the growing season has extended approximately two weeks since 1983. This was viewed as potential benefit to the state as it would allow for plant matter to store more carbon, potentially increasing the profitability of the state's nascent carbon marketplace for coastal restoration.

Two researchers, Tim Osborn and Steve Gill, at the National Oceanic and Atmospheric Administration concluded in interview with *The Lens* in 2013 that based on updated tide gauge data under peer-review, Louisiana will experience one of the highest rates of sea level rise in the world due to the combination of local sea level rise and coastal subsidence. Southeast Louisiana in particular would experience at least 4.3 feet of sea level rise by 2100, which would be deleterious to the operation of many of the planned restoration projects for the region. They cautioned that Louisiana needed to incorporate this new forecasted rate into the master planning process as soon as possible so as to not build projects that would be unusable in a few decades.

This led to a fiery response from then-Chair of CPRA, Garret Graves, culminating in his statement in a follow-up *Lens* article that "the NOAA folks are just misinformed. Yes, we expect things to change, and, yes, we can adapt these projects as we move forward," (Marshall 2013a). Graves felt that the master plan process already had mechanisms built in to incorporate new scientific information, in this case through the regular five-year plan updates, so there was no

reason to adjust implementation schedules for projects in the, then-current, 2012 master plan. He also disagreed with how the NOAA study calculated the rates of forecasted sea-level rise and coastal subsidence to quantify the forecast of at least 4.3 feet of sea-level rise by 2100 as it differed from the method used by CPRA during the process of writing the 2012 plan. Neither of these arguments addressed the central tenet of Tim Osborn's argument, that the restoration projects built during the plan's fifty year lifespan could not adapt to continue operations in the decades following if they were underwater due to sea-level rise. Graves's strong stance against the updated NOAA estimates may have stemmed from his own political leanings than a true position being taken by CPRA. Indeed, this conflict ultimately was short-lived as Graves resigned his position in February 2014 to embark on a successful campaign for a seat in the US House of Representatives, representing Louisiana's 6th Congressional district. Graves was a Jindal appointee to the CPRA who often added his voice in support of Jindal's position on the SLFPA - E levee oil and gas industry lawsuit as well as accepting donations for his 2014 campaign from the Koch brothers, noted climate change deniers (Murphy 2014).

Supporting this conclusion, by 2016 there was discussion of the need for CPRA and Louisianians to be more realistic about the amount of expected sea-level rise by 2100 and to incorporate those more realistic projections into the 2017 master plan update. It was clear that the 2012 plan had underestimated the amount of sea-level rise the region would experience as the worst case scenario in the 2012 plan was now expected to be the rosiest case scenario in the new 2017 plan. CPRA leaders begin acknowledging in 2016 that it was no longer possible for Louisiana to achieve a "no net loss" scenario for the state's wetlands with master plan projects, a goal that the 2012 plan anticipated accomplishing by 2032 with its best case scenario. There was

also an acknowledgement that state leaders and CPRA needed to shift their focus to more non-structural projects such as elevating existing structures and beginning the process of relocating communities as a result of sea-level rise projections.

Unlike with "climate change/sea level rise," there is a clear values debate at the core of the controversy that erupted in 2014 (see Figure 5.5) around the construction and use of sediment diversions in the Mississippi River to restore the coast. It was brought to the public's attention in 2014 that the science behind the sediment diversions was not as "proven" as the 2012 Plan had indicated through press coverage of the 2014 State of the Coast conference and of a series of reports published by a panel of experts assembled by The Water Institute of the Gulf to study the feasibility of the planned sediment diversions. The State of the Coast conferences are biennial state-level meetings where scientists present and share their research into the coastal erosion problems the state faces; The Water Institute of the Gulf is a non-profit research institute located in Baton Rouge. Because there is no peer-reviewed scientific evidence that the sediment diversions will work as no sediment diversions on the scale designed have ever been built and operated before (Turner 2009; Wells et al. 2014a; Wells et al. 2014b; Wells et al. 2015a), it is easy for the debate around whether diversions will be helpful or harmful to the people living in southern Louisiana to shift from a much needed science debate to one more focused on values, but still couching their arguments in science.

Many commercial fishermen and oyster farmers compose the 'against' faction, arguing that freshwater from the proposed diversions will too drastically change the salinity of their fishing and harvesting grounds. They feel there is a precedent for their concerns: the existing freshwater diversions at Davis Pond and Caernarvon. Both of these diversions were designed and

built during 1980s and 1990s, Caernarvon became operational in 1991 and Davis Pond in 2002, to decrease salinity levels and reduce wetland erosion caused by saltwater intrusion. The fresher water on public oyster grounds was expected to improve the oyster harvest. Some oysterman though were against these freshwater diversions, accurately predicting that the sediment and freshwater would severely damage their oyster beds. The Environmental Protection Agency (EPA) determined that Louisiana would have to address this damage to the oyster beds by halting the renewal of the fifteen year leases of the water bottoms affected by the diversions. Despite this determination, the Louisiana Department of Wildlife and Fisheries continued renewing the leases, leading to sustained losses by oystermen. Some oystermen filed a lawsuit against the state, wining a $2 billion verdict that was ultimately overturned in 2004 by the Louisiana Supreme Court on the grounds that the state constitution necessitated environmental benefits take precedence. This is reminiscent of the ultimately false promises of reimbursement for losses made to the residents of St. Bernard & Plaquemines Parishes in 1927 by state leaders before the state dynamited a section Mississippi River levee at Caernarvon at the behest of city leaders in New Orleans. In both cases unexpected damage was caused to those who make their livelihoods on the southeastern coast of Louisiana by state actions and legal recourse brought no recompense.

Fishermen and oystermen have continued to protest the non-responsive management of the Carnarvon Diversion, arguing that their concerns and direct observations of the wetlands affected by the diversion are not being heard by the USACE, which operates the diversion. Given this experience, they do not feel confident that their concerns will be listened to, and adjustments made to operations of the proposed sediment diversions, if needed. Already, CPRA scientists

predict a shift in the location of salt and brackish species of aquatic life once the sediment diversions become operational, requiring of fishermen more resources to reach to the location of the expected fishing grounds. Fishermen argue that the economic impact of the increase in resources required to obtain the same catch are not being appropriately factored into the modeling efforts around the impacts of the sediment diversions. This argument has merit as five of the seven reports produced by a Water Institute of the Gulf independent panel of non-Louisiana-based scientists noted that the social science and modeling efforts to study the impact of the sediment diversions were far behind those of the physical science modeling efforts (Wells et al. 2014a; Wells et al. 2014b; Wells et al. 2015b; Wells et al. 2016a; Wells et al. 2016b).

The fishermen also raised concerns about excess nitrogen and phosphorus nutrients from agricultural runoff and pollutants in diverted river water affecting the marshes it would flow through. Citing R. Eugene Turner and colleagues' work (Darby and Turner 2008a; Darby and Turner 2008b; Swarzenski et al. 2008; Turner et al. 2009; Turner 2011; Kearney et al. 2011; Turner 2014), those against contend that sediment diversions would actually be harmful, not helpful to coastal wetlands as they would weaken the root systems of marsh plants, making them more susceptible to washing away. Some scientists contend this is the reason there was increased destruction of coastal marshes affected by the Caernarvon Diversion after the passage of Hurricanes Katrina and Rita in 2005 as compared to other non-affected marshes (Barras 2006; Barras 2007; Howes et al. 2010; Kearney et al. 2011). Deegan et al.'s (2012) work also calls into question the assumption that coastal marshes would be able to sequester and neutralize excess nutrients in diverted river water, lending credence to the concerns that large diversions would be a very ecologically costly mistake for coastal Louisiana. While Deegan et al. (2012) conducted

their study in New England, fishermen commented that large algae blooms and smaller dead zones have been appearing in the Breton Sound and Barataria Bay, in addition to the larger Gulf of Mexico dead zone, due to the existing diversions in the last few years.

Captain George Ricks, president of the non-profit advocacy group The Save Louisiana Coalition that supports alternatives to the proposed diversions, disputes the designation of Wax Lake Outlet near Morgan City as a success story for the land building capabilities of the Mississippi River, pointing out that with 10% of the Mississippi River's flow (Wax Lake Outlet was designed with a capacity of 300,000 cfs) the outlet only creates about 250 acres per year since 1983, which potentially calls into question the rosy land building estimates of the 2012 plan. There were also concerns raised by Brigadier General Duke DeLuca, the commander of the USACE's Mississippi Valley Division, about the proposed diversions receiving approval from the USACE for construction and operations, a necessary step as the diversions will necessitate altering the Mississippi River & Tributary Project levees operated by the USACE. Per Brigadier General DeLuca, each diversion would need to obtain two different permits from the USACE, one that certifies compliance with the Clean Water Act provisions that require projects be environmentally sound and another that requires the diversion will not disrupt the existing federal, state, and private projects. This would likely provoke involvement of the navigation and shipping interests that traverse the Mississippi River Delta, adding more complications and uncertainties to the projects.

Those against the diversions are not advocating for a do-nothing approach, but they have not been convinced by the information presented by CPRA that sediment diversions, as proposed, are the best solution. Instead, they suggest constructing smaller sediment diversions,

with more efforts being made to learn from those diversions before constructing the currently proposed larger-scale diversions and/or increasing dredge-and-fill efforts that create land on a shorter time scale than the diversions are forecasted to do. Dredge-and-fill is a land restoration method where sediment is dredged from a source, such as the river bottom, and then piped to another location where it is used to fill-in a deteriorating marsh. The dredge-and-fill solution is viewed as more trustworthy as it is one that fishermen are familiar with, it has been used multiple times in the wetlands of Louisiana for successful land restoration projects with minimal negative impacts, though the land created this way does erode requiring further dredging-and-filling to sustain it. Those against feel like the master plan was developed in Baton Rouge for the benefit of the urban areas in the southern part of the state; it is being forced on those in the coastal parishes who will be most immediately affected. The push for the sediment diversions may be the twenty-first century analog of the destruction of the Caernarvon levee as it will protect urban areas at the possible expense of the livelihoods of those not powerful enough to stop it.

The 'for' faction's argument centers on the fact that coastal degradation has gotten so bad that something major must be done because time is running out for the wetlands of Louisiana. With the support of the National Wildlife Federation (NWF) and the Environmental Defense Fund (EDF), they see the proposed diversions as the only option to halt the land/marsh loss. In their view, humans have interrupted the natural cycle of the Mississippi River Delta by extensively leveeing it for flood control since the 1927 Flood, preventing the river from flooding the deltaic flood plain and thus cutting off the delta from the river. Thus to save the eroding wetlands the river must be "turned loose" and allowed to return to its "natural" state. They further argue that as the diversions will mimic natural processes, they will create healthy

marshlands that will help protect those living in the coastal parishes from storm surges. They argue that the wasted sediment of the river can be seen in satellite photos spilling in the Gulf of Mexico, or in recent years into Lake Pontchartrain as a result of the opening of the Bonnet Carré Spillway and that taxpayers are already paying $80-$100 million per year to dredge sediment out of the Southwest Pass. All of that river sediment could save the Louisiana coast if the sediment diversions were operational.

As seen with the previous paragraph, the core of the 'for' argument seems to rely on an emotional feeling that a large scale solution must be accomplished as the problem of coastal erosion has become existential for southern Louisiana. Many of the newspaper articles that were 'for' the diversions used calls to shared values of hunting and fishing in the eroding marshes and the memories contained in those places that are disappearing from the map. They also pointed to the successful land building that has occurred at the previously mentioned Wax Lake Outlet and at West Bay. Both these projects have been successful in creating land, though in the case of Wax Lake it was by accident as the project was not designed by the USACE to do so. This success has led to a measure of hubris of anthropogenic land building capabilities, with Bren Haase, then-assistant administrator with the planning and research division of CPRA, claiming "if this can happen on accident, what are the possibilities that we can plan and thoughtfully design one like it," (Wold 2014). As to the claim from the 'against' faction that Wax Lake demonstrates that the proposed diversions will not build land at the rates given in the 2012 plan, the rejoinder was that Wax Lake had built land at a slower rate due to its location in a deep, high energy bay, which inhibits deltaic growth. This would not be a factor for the proposed diversions as they will be operating in areas that are shallow with broken marshes which will help capture and retain

sediment from the river flow, consequently allowing diversions to build land faster than observed at Wax Lake.

The other land building success, West Bay, was designed to build land from the start as it was the first sediment diversion constructed in the state. It became operational in 2003 and is located at river mile 4.7 above the Head of Passes (Miller 2004). West Bay is an uncontrolled diversion, meaning river water flows freely through a designed breach in the river levees (Miller 2004). Despite being viewed as a land building success, only one article in the corpus focused on it. That article covered a hearing on overturning the 2008 decision by the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) task force to close the diversion. Several other articles mentioned it briefly, usually with one sentence indicating it was a success and thus the proposed diversions would also be successes. West Bay was designed to mimic the natural deltic processes through acting as a crevasse (Bush 2018). It had been designated for closure in 2008 because it was suspected in causing shoaling in the Pilottown Anchorage Area, affecting navigation, and for it not being particularly successful at land building (Bush 2018). One resident of Plaquemines Parish who lived near the diversion commented in a public CWPPRA meeting that the West Bay diversion was more successful based on his direct observations than the task force monitoring had indicated (Bush 2018). He also felt strongly that given that the diversions was building land, that more research should be done to confirm that the diversion was the cause of the shoaling in the anchorage area (Bush 2018). His observations ultimately led to the diversion being deemed a success and winning a reprieve from closure. Given the importance of effective monitoring for adaptive management to work, it is very concerning that a sediment diversion was almost closed and labelled a failure by the state due to lack of monitoring.

The ‘for’ faction also pushed back on several of the claims made by the ‘against’ faction, arguing for one that the proposed diversions in the plan would not be operated the same way that Caernarvon and Davis Pond have been since they are designed to fulfill a different purpose. While they do agree with the ‘against’ faction on the likelihood of fishermen needing to travel farther to haul their catch once the diversions are operational, the current fishing patterns/ locations the fishermen are seeing are unnatural and a consequence of a collapsing delta. Marsh degradation has created in an increase in habitat for salt-water species, but that is not worth allowing the entire delta ecosystem to completely collapse. They feel that those ‘against’ diversions are attempting to use short-term inconveniences, such as having to travel farther to fish, to prevent the implementation of the projects at the expense of long-term solutions that would save the wetlands, and thus the fisheries as well. Indeed some fishermen agree with the ‘for’ faction that diversions are needed to help the fisheries as they have observed better fishing at the Wax Lake Outlet since its been an operational diversion. Likewise, the ‘for’ faction disputes the findings in Deegan et al. (2012), arguing that Morris et al. (2013) and Nyman (2014) have come to the opposite conclusion regarding sediment diversions, that they would not be ecologically detrimental to existing wetlands based on the response of existing freshwater diversions to the nutrient load in the river.

CPRA has determined through modeling efforts that smaller diversions and dredge-and-fill efforts suggested by those ‘against’ would be more expensive and likely more detrimental to fishermen in the long run. Smaller diversions would result in more sediment settling onto the oyster beds downstream of the diversion than would occur with fewer, larger diversion according to CPRA modeling. Additionally, while dredge-and-fill is a more familiar technology to many

along the coast, CPRA argued it would be far more expensive to use this method in most cases as compared to sediment diversions. Dredging also cannot capture the suspended sediment load of the river, estimated to be roughly four times of that which settles to the bottom, meaning more resources have to be used to obtain the same amount of sediment that is dissolved in the river. Marshes built through dredging start to deteriorate as soon as the project is completed as there is no continuing sediment input to counteract the subsidence of the delta as a whole, leading to continuous costs to maintain these marshes that are not expected to occur with sediment diversions. Sediment diversions are not expected to build land as immediately as dredging-and-filling would, but CPRA believes they will ultimately be a more effective and economical method for restoring coastal wetlands than the suggestions put forth by those 'against.'

Another reason put forth for constructing sediment diversions is that scientists have been learning much more about the science and engineering of diversions on the Mississippi River in recent years. Building on the work of Sherwood Gagliano, John W. Day and colleagues have studied how marsh elevations have responded to freshwater diversions in the Mississippi River delta, generally finding that marshes responded well, continuing to accrete at a rate that is greater than that of sea level rise (Lane et al. 2006; Moerschbaecher 2008; Day et al. 2009). This work appears to be the foundation of the 'for' faction prior to the study period. Day also led the Mississippi River Delta Science and Engineering Team, an assemblage of 22 scientists from Louisiana and across the USA that was supported by The National Audubon Society, the EDF, and the NWF, which published a brief report in 2012 whose purpose was to answer the scientific questions around sediment diversions on the Mississippi River and make the case for why the

diversions were badly needed (Day et al. 2012). That report was expanded into a book, released by Springer in 2014 as part of the Estuaries of the World series (Day et al. 2014).

During the study period, scientists working on the USACE's Louisiana Coastal Area Hydrodynamic and Delta Management Study released preliminary findings that there was enough sediment in the river to supply the predicted needs of sediment diversions. Another important finding was that the amount of sand, a key ingredient for land building, had not significantly decreased with the leveeing of the river and is expected to remain stable for the next 600 years (Nittrouer and Viparelli 2014). Other important findings during the study period included that the diversion angle of approach to the river was not particularly important for successful diversion operation, determining how much water can be siphoned off the river through diversions before navigation impacts are likely to be felt, how much water needs to flow through a diversion to maximize sediment capture, and when the maximum sediment loads in the river actually occur. Scientists also determined that the Atchafalaya River was better at building land than the Mississippi due to its slower flow rate (Falcini et al. 2012).

Several large studies were also announced as just beginning during the study period as well. The first was the previously mentioned Louisiana Coastal Area Hydrodynamic and Delta Management Study conducted by the USACE. This five year study was begun in 2013 and was the first such study since the 1960s to detail the hydrodynamics of the Mississippi River delta, including the river's volume and sediment load. This study was also the first time the USACE considered navigation, flood control, and coastal restoration as three linked uses of the Mississippi River. The study was authorized by Congress in 2007 but not funded until 2011, so the CPRA used data from the 1960s on how the lower river was believed to operate for the 2012

master plan. To help provide objectivity, an expert panel on the river diversions was created in 2013 by the Water Institute of the Gulf. This independent panel of non-Louisiana-based scientists published seven reports over the three years the panel met (2014-2016) that provided guidance and critiques on the science underpinning the 2012 master plan and the progress CPRA was making on answering questions raised about the diversions. One of this panel's major recommendations became a separate study that CPRA announced they were beginning in 2015: a socio-economic analysis of the expected impacts of sediment diversions on the fishing industry. The final project announced that began during the study period was an examination of the land building that occurred at the Davis Pond freshwater diversion. Long considered to be too small to build any land, Davis Pond had not been as well-studied as the Caernarvon diversion. The focus of this 2015 study was to determine how Davis Pond actually built land given the assumptions about the sediment and water flow requirements for land building.

Those 'for' sediment diversions contend that diversions have been used in Louisiana since the 1930s. Indeed, two of the many arguing for diversions, Jeff Herbert, the chief resilience officer for the City of New Orleans and David Muth, the director of Gulf restoration for the NWF, make the claim in their letters to *The Baton Rouge Advocate* and *The New Orleans Advocate* in January 2016 that controlled sediment diversions have been extensively studied. That does not seem to be the case. Both statements give the impression that sediment diversions are a well-known and understood restoration technology when at best it is an emerging technology that the state would be experimenting with and learning from as it is operated. While it is true that diversions have been used since the 1930s, they have primarily been flood control diversions, used to channel water away from the Mississippi River so it does not overflow its

banks and damage property. Freshwater diversions to control salinity have been used since the late 1980s and are still being studied to determine their effectiveness at land building. While newspapers did cover research being done to support sediment diversions, both work published in peer-review and those studies just beginning, significant gaps in knowledge, and data, remain. The two review panels on scientists, one composed of scientists who served on the Technical Panel from the *Workshop on Response of Louisiana Marsh Soils and Vegetation to Diversions* and the other the previously mentioned Water Institute of the Gulf panel, concluded there were major gaps in data availability and knowledge regarding how the existing freshwater diversions have affected downstream marshes due to a lack of knowledge regarding the receiving basins themselves (Teal et al. 2012**;** Wells et al. 2014a). The Teal et al. (2012) report reviewed the published peer-review literature on the impact of the existing freshwater diversions and found "…that little evidence was available that any Freshwater Diversion in the Louisiana deltaic plain has significantly reversed the rate of marsh degradation and land loss," (Teal et al. 2012). Another key finding was that there were no studies completed that looked at how river water had affected the vegetation and herbivores of the diversion receiving basin (Teal et al. 2012). One of the peer reviewers of Teal et al. (2012), Chris Swarzenski, put it best: "It seems everyone has just taken for granted the slogan 'Put the river back in the marsh' as the key to addressing the problem without ever going out in a scientific way to find out what that would do," (Marshall 2013b). These findings evoked a strong response from Garret Graves, with him dismissing them as too little, too late to apply to the master plan and arguing that the Louisiana must move forward with the science that it has, not the science it would like to have (Marshall 2013b).

The series of reports published by the Water Institute of the Gulf panel (Wells et al. 2014a; Wells et al. 2014b; Wells et al. 2015a; Wells et al. 2015b; Wells et al. 2015c; Wells et al. 2016a; Wells et al. 2016b) were designed to provide feedback on CPRA's progress in answering the questions around the science of sediment diversions as well as how these projects would best be operated to maximize sediment delivery while minimizing detrimental impact. Besides being concerned with the initial data gaps, the panel expressed continued concerns regarding insufficient data sampling and monitoring strategies as plans for the adaptive management that were being developed. In particular, this panel repeatedly drew attention to the lack of socio-economic analysis in the data modeling efforts, pointing out that without this analysis it would be impossible to fully understand the impacts of sediment diversions on those that live and work along the coast. This analysis was one the newly begun studies mentioned previously. Once the study was begun, though, the panel expressed concerns at the slow pace of progress in that arena as compared to the physical components of the project (Wells et al. 2016b). The panel wrote in the fourth report that CPRA was at risk for project implementation being greatly impacted by having a poor understanding of the human impacts the diversions are likely to cause, particularly in regard to their operation, making a successful adaptive management plan key.

Taken all together, both sides of the sediment diversion debate have positions they feel are supported by the available science when at the core it is a dispute over values. Those against diversions vehemently argue their position because they believe their values, to be able to continue their way of life and support their families, are not being considered by the officials in Baton Rouge involved with the coastal master planning process. Many of the proponents for the diversions likewise argue that the problem of coastal erosion has gotten so bad that the proposed

diversions are the only option to halt the land/marsh loss and protect residents from flooding from storms. This assumption is based on the output of computer modeling simulations designed to replicate the expected behavior of the Mississippi River with diversions, models that according to two review panels of the scientists are missing data or built on dated assumptions. The conflict over sediment diversions may be a bit of a red herring though, with the two sides fighting each other one major player in coastal Louisiana is completely absent from the conversation: the oil and gas industry. As stated previously, the oil and gas industry is responsible for destroying roughly one-third of wetlands lost through the canals it dredged. With so much energy being spent arguing about sediment diversions, few are occupied holding the industry accountable for the damage it did and continues to do through lack of environmental remediation for old canals. The conflict over sediment diversions may also be unnecessary, as two articles covered a 2014 study in the journal Ecological Economics found that found sediment diversions and dredge-and-fill, the suggested alternative of the 'against' faction, compliment each other in terms of cost efficiency and land building rates, particularly during the early years of operation for a diversion (Caffey et al. 2014).

In spite of all the conflict surrounding sediment diversions, it is still not a sure bet that they will actually be constructed, only a likely one, as many engineering and permit hurdles remain to be cleared. There is no USACE manual describing how to design a diversion of the size planned, and then to capture sediment, so many design features are being determined for the first time, and there are still questions to be answered about how to incorporate the structure into the existing federal river levees. There are also issues around flood control, how to design a sediment diversion so it does not become a conduit for storm surge flooding, the way the now-

closed Mississippi River Gulf Outlet (MRGO) became. Concerns were raised in 2013 by the National Marine Fisheries Service (NMFS) regarding potential impacts to fisheries that would potentially be in violation of the Magnuson-Stevens Act. The concerns raised by the NMFS did not halt the planning phase for the Mid-Barataria Sediment Diversion, but those concerns would need to be addressed in the environmental impact statement CPRA would need to develop when it requests construction permits from the USACE, otherwise the project timeline could be delayed or halted altogether. CPRA was quick to point out during debates around sediment diversions that the agency had not committed to actually building one, that they were only in the planning phases.

In fall of 2015 that changed with the vote to move forward with two diversions, the Mid-Barataria near Myrtle Grove and the Mid-Breton near Wills Point. With that vote, it was still expected to be at least three more years before construction would begin on either diversion, but both projects would move from planning to the final stage of engineering and design. That final stage was expected to take roughly two years with another year after being spent securing the necessary permits. Even after the vote the sediment diversions were not seen as sure things, as shown with Johnny Bradberry's, the new chairman of CPRA in 2016, stated commitment to "accelerate the research on diversions to either move them forward or discard the idea," (Wold 2016). The state continued to move forward with the diversions as the scientific research continued with a proposal request by CPRA for companies to complete the environmental impact statement for the Mid-Barataria diversion by the end of the study period in late 2106.

General DeLuca, the former commander of the USACE's Mississippi Valley Division, described the 2012 master plan as untested and unfunded, which in many ways was true.

Louisiana is on the leading edge of scientific research into coastal restoration, with uncertainty regarding the impacts of climate change on the projects as well as if controlled sediment diversions can actually replicate the land building capacity of the pre-European settlement Mississippi River delta. The state has the funds for only a portion of the total $50 billion needed, but enough to construct one of the sediment diversions. Critically though, sediment diversions would not prevent or restore the land loss occurring on the western and central portions of the coast as they are too far from the Mississippi River, meaning much energy and limited resources are being expended on only a portion of the entire state coastline.

**Figures and Tables**

| Newspaper | Number of Articles |
|---|---|
| *The Times-Picayune* | 109 |
| *The Advocate* | 146 |
| *The New Orleans Advocate* | 54 |
| *The Acadiana Advocate* | 29 |
| *The Lens* | 46 |

Table 5.1: A list of the five newspapers included in this study and the number of articles published during the study period that covered the science involved with or the financial aspects of the 2012 Coastal Master Plan.

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| Financial | Allocation of Money | |
| | Miscellaneous | |
| | Project Costs | |
| | Political Maneuvering | Federal - Attempt |
| | | Federal - Success |
| | | State - Warning |
| | | State - Attempt |
| | | State - Success |
| | | Parish - Attempt |
| | | Parish - Success |
| | Sources of Funding | Deepwater Horizon - Certain |
| | | Deepwater Horizon - Uncertain |
| | | Certain |
| | | Uncertain |
| | | Against |
| Science | Adaptive Management | |
| | Climate Change/Sea Level Rise | 2017 Plan Revision |
| | | Conflict |
| | | Observation |
| | | Research |
| | General Coastal Restoration | |
| | Sediment Diversions | Built Diversion |
| | | Conflict |
| | | Natural Diversion |
| | | Problems/Uncertainty |
| | | Research - Beginning |

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| | | Research |
| | Miscellaneous | |

Table 5.2: Table of the qualitative content analysis coding frame developed to better understand the public discourse around two areas of uncertainty, science and financial, and the 2012 Louisiana Coastal Master Plan. There are two main categories in the first dimension, “financial” and “science,” followed by a further five subcategories under each main code. Four of the subcategories, “political maneuvering” and “sources of the funding” under “financial” and “climate change” and “sediment diversions” under science, were additionally sub-coded to further elucidate the uncertainties being discussed therein.

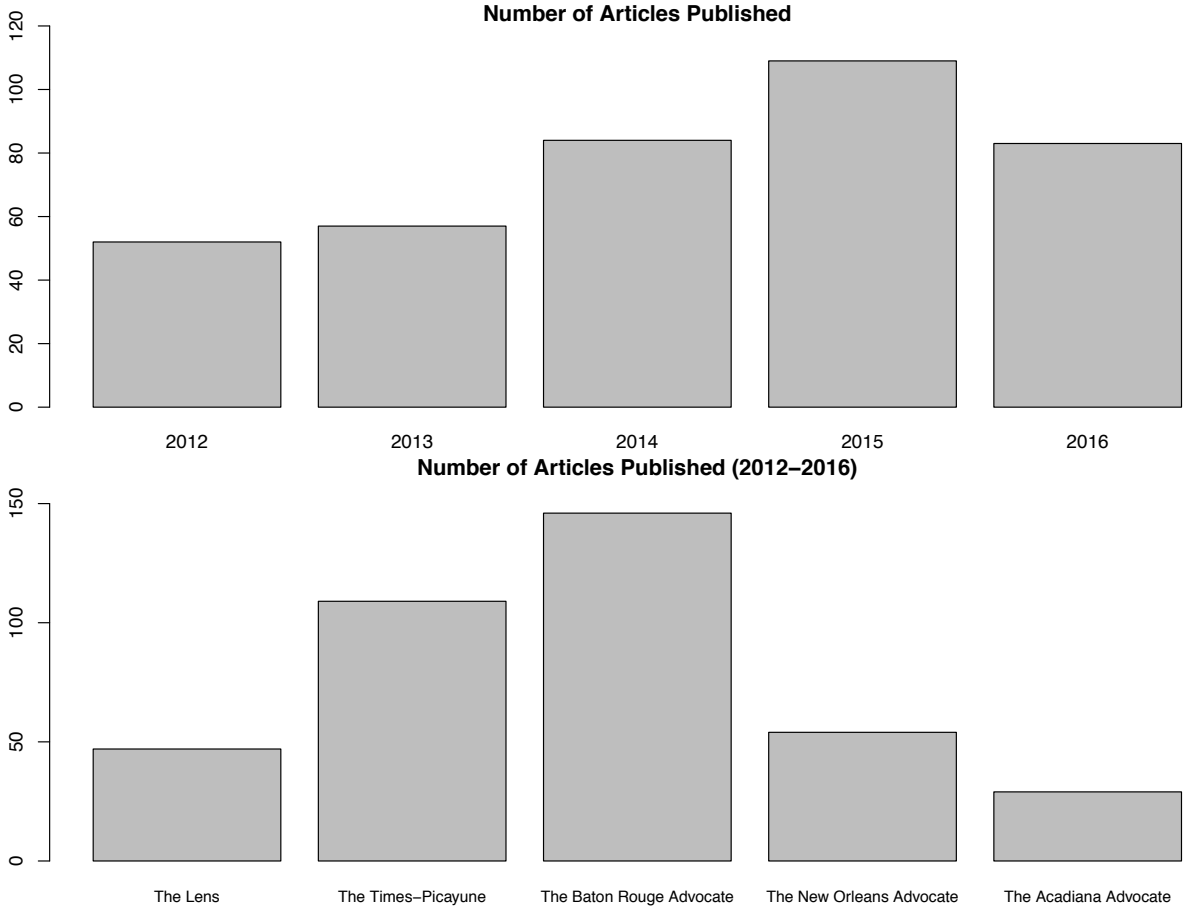


Figure 5.1: Graph of the number of articles in the corpus. The top graph shows the number of articles published per year included in the corpus while the bottom graph presents the number of articles published per individual paper in the corpus.

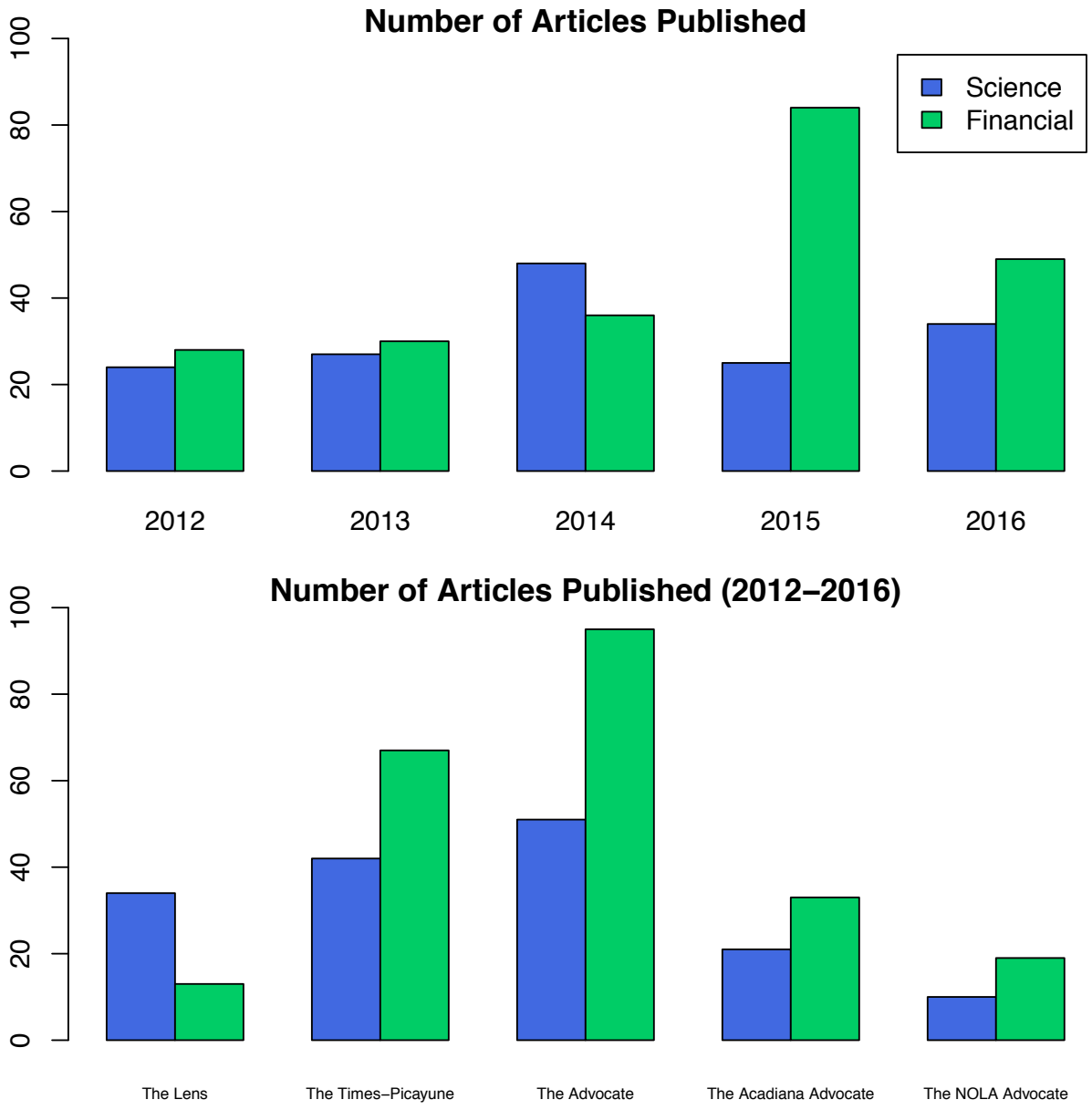


Figure 5.2: Graph of the number of articles coded as "science" and "financial" included in the corpus. The top graph shows the number of articles published per year for each code while the bottom graph presents the number of articles published per individual paper.

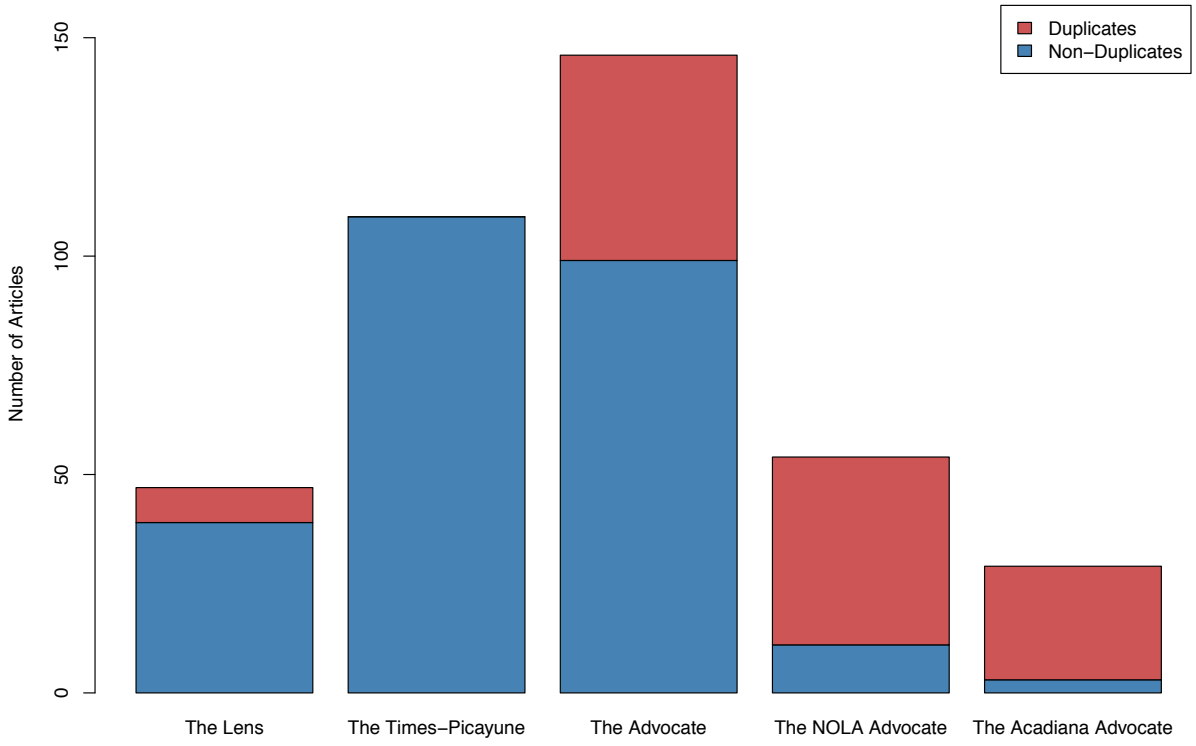


Figure 5.3: The number of articles classified as duplicate published by the five newspapers.

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| Financial: 59% ( n = 227) | Allocation of Money: 18.1% (n = 41) | |
| | Miscellaneous: 8.8% (n = 20) | |
| | Project Costs: 7.9% (n = 18) | |
| | Political Maneuvering: 33.5% (n = 76) | Federal - Attempt: 27.6% (n = 21) |
| | | Federal - Success: 2.6% (n = 2) |
| | | State - Warning: 26.3% (n = 20) |
| | | State - Attempt: 34.2% (n = 26) |
| | | State - Success: 5.3% (n = 4) |
| | | Parish - Attempt: 2.6% (n = 2) |
| | | Parish - Success: 1.3% (n = 1) |
| | Sources of Funding: 31.7% (n = 72) | Deepwater Horizon - Certain: 20.8% (n = 15) |
| | | Deepwater Horizon - Uncertain: 16.7% (n = 12) |
| | | Certain: 5.6% (n = 4) |
| | | Uncertain: 54.2% (n = 39) |
| | | Against: 2.8% (n = 2) |

Table 5.3: Table of the financial portion of the coding frame with the second and third dimensions. The number of articles coded under each sub-code and the percent of the total the sub-code represents is included in the cell with the code name.

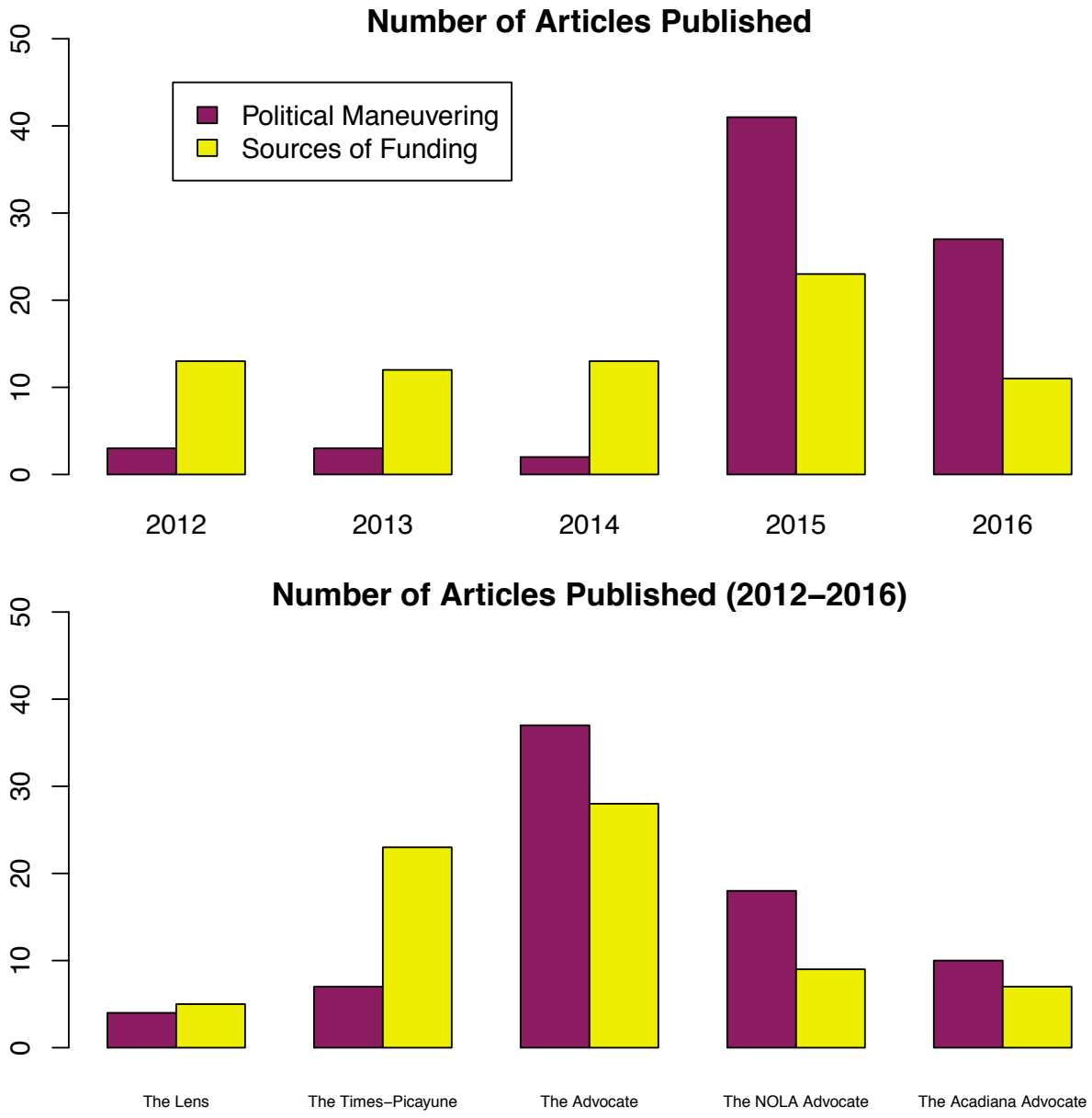


Figure 5.4: The frequency of occurrence of the "political maneuvering" code as compared to the "sources of funding" code in the study corpus. The top bar graph shows the change in frequency per year while the bottom graph shows the change in frequency by newspaper.

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| Science: 41% (n = 158) | Adaptive Management: 0.6% (n = 1) | |
| | Climate Change/Sea Level Rise: 13.3% (n = 21) | 2017 Plan Revision: 33.3% (n = 7) |
| | | Conflict: 4.8% (n = 1) |
| | | Observation: 9.5% (n = 2) |
| | | Research: 52.4% (n = 11) |
| | General Coastal Restoration: 7% (n = 11) | |
| | Sediment Diversions: 58.9% (n = 93) | Built Diversion: 1.1% (n = 1) |
| | | Conflict: 41.9% (n = 39) |
| | | Natural Diversion: 4.3% (n = 4) |
| | | Problems/Uncertainty: 20.4% (n = 19) |
| | | Research - Beginning: 8.6% (n = 8) |
| | | Research: 23.7% (n = 22) |
| | Miscellaneous: 20.3% (n = 32) | |

Table 5.4: Table of the science component of the coding frame with the corresponding second and third dimension codes. The number of articles coded under each sub-code and the percent of the total the sub-code represents is included in the cell with the code name.

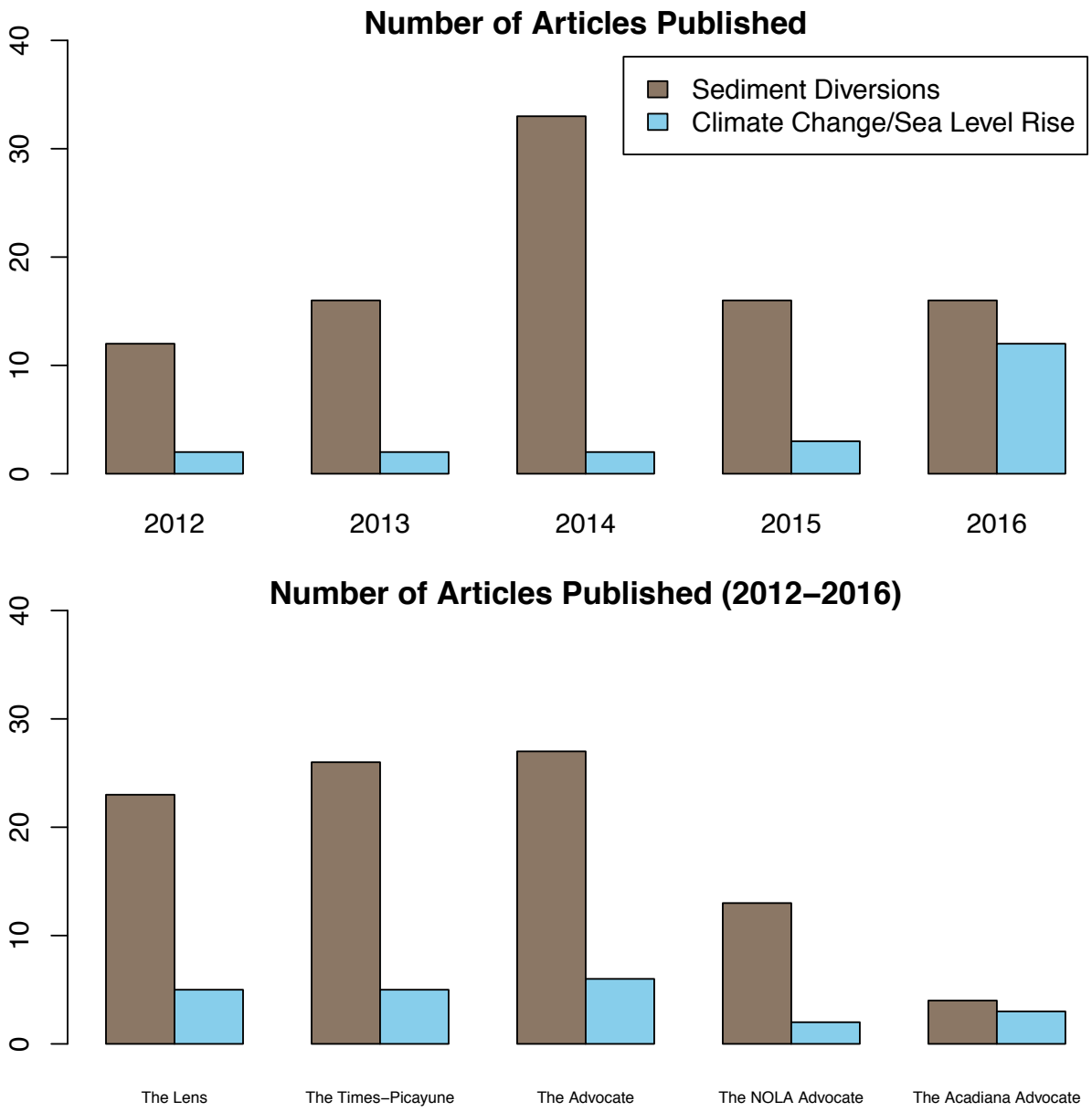


Figure 5.5: The frequency of occurrence of the "sediment diversions" code as compared to the "climate change/sea level rise" code in the study corpus. The top bar graph shows the change in frequency per year while the bottom graph shows the change in frequency by newspaper.

# Chapter 6: Stakeholder Analysis

Sixteen of the fifty-eight Framework Development Team members agreed to participate in this study. At least one representative from each of the six stakeholder groups, federal, state, and local governments, non-governmental organizations (NGOs), industry, and academia, that are or will be affected by coastal erosion in the state agreed to be interviewed. The stakeholder group membership of the team members who agreed to participate, Figure 6.1, differs from the group membership of the total Framework Development Team, Figure 4.3, in that there is a much larger federal stakeholder proportion than in the original group. The anonymity of responses was very important to some of the participants, so much so that two refused to name specific people when directly asked about policymakers' understanding of the science of the Master Plan and admitted to being intentionally vague in answers to other questions as a method of protecting themselves. This may have resulted in more focus on those perceived to be well-versed in the science as compared to those policymakers that were not. All participants were told during the consent process that their interview would be transcribed, anonymized, and the recording destroyed. Given the small number of interviewees from the non-federal stakeholder groups, and the public listing of the Framework Development Team (CPRA 2017), I am not going to be analyzing responses within groups in order to further anonymize participants. I will discuss the themes that emerged from the data as whole, with the knowledge that the whole is more proportionally federal stakeholders.

## Perceptions of Policymakers' Science Knowledge

Given the complex nature of many of the projects in the master plan, and the corresponding uncertainties, scientific knowledge cannot just flow from the top, be it the state or

federal level, down the local level if the plan is to be successfully implemented. As already mentioned with the West Bay Sediment Diversion, local residents can play an important role in the long term success of a project, if they are not dismissed by those at higher levels (Bush 2018). Scientists are typically much more comfortable with uncertainty than many decision makers, leading the latter to push for more rigidity and certainty in implemented policies as well as having a lower tolerance for innovation (Bradshaw and Borchers 2000), which could lead to major implementation challenges given the state's chosen strategy for managing uncertainty, adaptive management. As local, state, and federal policymakers are involved with funding, research, and/or construction of master plan projects, understanding how policymakers at all levels are engaging with scientific information related to the master plan can help in identifying potential future friction points for plan implementation. Stakeholders involved in the process can provide valuable insights about those in positions of power. Figure 6.2 shows the thematic map of perceptions of scientific knowledge and understanding for all three levels of government.

Local/Parish-Level Perceptions:

Louisiana is a home rule state, which allows parish policymakers to make land use decisions that may differ from the goals of the coastal master plan (Knox 2017). This raises the importance of having well-informed local-level policymakers who understand the science of coastal restoration and can align local land use/land planning efforts with the master plan. Many of the interviewees perceived a lot of variation within the local-level governments in terms of understanding the science. In general, local-level officials in Louisiana were seen as being more knowledgeable than their counterparts in other states. Parishes directly affected by sea-level rise

and land loss, often the same ones that employed coastal zone managers, in particular were felt to have a good basic grasp of the science of coastal erosion and restoration. Many of those parishes also had experience working with the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) program on restoration projects similar to those proposed in the coastal master plan, with the exception of sediment diversions, so interviewees felt that those officials would also generally understand the restoration science.

Another theme that emerged at the local/parish level was that some local-level officials were seen as making a willful choice not to learn more about the science, either due to the amount of issues already on their agenda or due to specific restoration projects appearing unlikely to be implemented in their parish. One interviewee reported,

> "Yeah, so I mean I do think there's a lot going on, obviously, that happens on a parish level. I mean it could be a garbage dustup you know what I mean. Yeah, so there's just... it could be something related to the school buses or something related to a congested intersection. I just think that there's so much that folks have to deal with on that parish and local level that while this is important to them, maybe they don't have the bandwidth to get into the science of it."

This "lack of bandwidth" could be a driver for the importance of trust at the this level, another theme that occurred and will be discussed in the next paragraph. This could be a symptom of short-sighted thinking on the part of these local officials, that because their communities or parishes are not imminently under water, coastal restoration is not a subject that they need to understand and focus on at the moment. It could also be due to more detrimental reasons, such as these officials paying lip service to the need for coastal restoration work in their parish, work that would be expansive and require potentially unpopular tax increases to fund, or due to the

influence of political donations to focus on a particular coastal restoration technique at the expense of others. Per an interviewee,

> "Local politicians go with where their donations are, unfortunately, you can see it just at this parish alone."

Lack of knowledge about coastal restoration science could be a strategic choice on the part of some local officials.

As mentioned earlier, the final theme in figure 6.2 at the local/parish level was trust. As a possible coping mechanism due to their recognized lack of knowledge, local-level officials want to work with people on these large restoration projects that they believe they can trust since there will likely be impacts to the economy of the parish. As one interviewee said,

> "So I think what a lot of this comes down to is trust. They really want to trust somebody but they may not feel comfortable that they can trust somebody who's going in pitching projects from the federal or state government to might-be science people. And I'll tell you the reason why the trust is so important is because what I got back to, we're dealing with livelihoods. Changing the environment in a way that can impact people. That's pretty scary to think of, you know for 20 years you've been successfully fishing, you've got everything kind of in place and somebody wants to come in and do something that changes the whole playing field, the whole game."

The coverage in the newspaper articles of the conflict around sediment diversions indicates that trust has likely not been established between local officials and scientists. While the newspapers focused on the values conflict between some fishermen and oystermen and the Coastal Protection and Restoration Authority (CPRA), local/parish officials maintained a lower profile

and did not appear to be taking a side in the conflict during the study period. There are some indications though that trust is evolving as some respondents mentioned new voices are stepping into the relationship space between the local/parish level and the state and are attempting to establish trust with new officials. These new voices are local level people viewed as understanding the science of the coastal restoration and are trying to represent the interests of the parish in some capacity as well as serving as a science translator to others in the parish that are not as well-versed in, or comfortable with, the scientific information.

There were several parishes that many of the respondents mentioned as having officials with a good understanding of the science of the plan, including Terrebonne Parish, Jefferson Parish, Lafourche Parish, and Plaquemines Parish in the eastern part of the state and Cameron Parish and Calcasieu Parish to the west. Several people were mentioned by name as understanding the science (Table 6.1) with a majority representing local interests in Terrebonne, Lafourche, and Plaquemines Parishes. All three parishes have experienced heavy land loss due to coastal erosion. The majority of people listed in table 6.1 are unelected officials working in parish government. Two individuals, Richie Blink and Gordy Dove, are elected officials. Simone Maloz is the only person listed who does not work for parish government, instead she is the executive director of Restore or Retreat, a non-profit coastal advocacy group that works as a boundary organization for those in the Barataria and Terrebonne Basins. A boundary organization is one that facilitates the flow of information and fosters collaboration between research disciplines and the public policy community (see Guston 1999; Guston 2001). Many in Table 6.1 are also involved with the coastal master planning process, with Wendell Curole serving as representative on the board for CPRA and Simone Maloz, Ryan Bourriaque, Marnie Winter, and

Mart Black serving on the Framework Development Team for the 2017 plan. Laurie Comier served as both board member for CPRA and a member of the Framework Development Team.

State-Level Perceptions:

General knowledge of coastal erosion and restoration is seen to be improving at the state-level but overall there is still a wide gulf of knowledge between those elected officials with districts directly affected in the southern portion of the state, who are perceived to have the greatest knowledge, and officials from the rest of the state, perceived to know the least if they know any of the science at all. As most state level politicians are not scientists, even those viewed to have the greatest knowledge were thought to only have a grasp of the basic science underlying coastal erosion and restoration. Unelected policy makers were predominately associated with the CPRA and were seen as having a much deeper understanding of the science, especially as this is the state agency leading the planning and research efforts and authoring the Master Plan documents. Overall, Louisiana was viewed as the most active of the five Gulf Coast states (the others being Alabama, Florida, Mississippi, and Texas) in addressing coastal erosion and restoration.

Chapter 2 discussed how the boundary between science and policy can be a murky and ill-defined when it comes to environmental problems; evidence of this is found in one of the state-level themes: scientific-soundness. This theme documented a belief that the level of legislative approval of the different iterations of the coastal master plan was connected to the quality of the plan. Both the 2012 and the 2017 Coastal Master Plans were unanimously approved by the Louisiana legislature. According to one interviewee,

> "So the Master Plan was approved unanimously by the legislature, both in 2012 and in 2017, and signed by governors of different political parties. So I think that that is a big testament to the plan and the scientific soundness of it. The way the plan worked, it was very much developed by scientists and technocrats, and the legislature just approved it, or yeah, they have the right to approve or disapprove it."

Others viewed this vote as evidence that policy makers had a general understanding of the plan. One should be hesitant to attribute these votes as evidence of scientific knowledge given the previously expressed variation in policymaker's science knowledge by interviewees. Louisiana is still trying to secure financing for the plan and is actively seeking it from the coffers of the federal government. Voting to approve or disapprove any version of the Master Plan is likely not connected to the scientific validity of the document as the voting process in the state legislature does not include peer-review of the plan. Instead it is a decision to allocate scarce financial resources at the state-level and to continue seeking financial resources at the federal level.

One of the overlapping themes between the state and federal level in figure 6.2 was the belief that there is still an "old guard" involved in restoration work that wants to use certain types of projects, structural ones at the state level or beneficial-use dredging for marsh creation at both the state and federal level for example. In describing the general support they perceived for structural protection measures, one participant said,

> "There is always a, there is often a bias towards building structural protections in the state, but I think that that often reflects that understanding that structural protection provide immediate or very predictable near term levels of, near to medium term levels of protection."

Because these are the types of projects that have historically been completed in Louisiana, the construction techniques for them are well known through direct experience to those at the state and federal levels and both types of projects appear to create benefits immediately as compared to diversions, which are expected to show demonstrable benefits ten to twenty years after construction. Pushing back against the "old-guard" are the perceived "new" scientists of the CPRA who argue, for example, that projects using beneficial-use dredging for marsh creation build land that only lasts a decade or so before disintegrating without further dredging and thus are not the type of projects the state should be funding. Those at CPRA believe sediment diversions are the state's best chance to restore the southeast portion of the coastline, even though that technique is a new one for those that have worked in restoration.

At the state level the CPRA was seen as the premiere state-level agency for their knowledge of the science underpinning the coastal master plan. Also mentioned were the Department of Natural Resources and its sub-department the Office of Coastal Management, and the Department of Wildlife and Fisheries, both of which lost staff to the reorganization that created the CPRA. Two more state level agencies were the Office of Community, involved with social science issues connected to the plan, and the Water Institute of the Gulf, an independent, non-profit institute located in Baton Rouge. The latter is not officially a state agency but has close ties to many of the environmental agencies and universities in the state. Only three people were mentioned by name at the state-level as understanding the science well, Jerome Zeringue, Bren Haase, and Dr. Denise Reed. Of the three, two possess current or past ties to the CPRA. Jerome Zeringue currently serves as a state representative Louisiana District 52, which includes parts of Lafourche and Terrebonne Parishes. Previously though he was the Chair of the CPRA.

Bren Haase was also mentioned as understanding the science, he was in charge of developing the 2017 State Master Plan. Dr. Denis Reed was formerly affiliated with The Water Institute of the Gulf and now serves on the National Oceanic and Atmospheric Administration (NOAA) Science Advisory Board.

Federal-Level Perceptions:

As with the previous two levels in figure 6.2, variation was again a theme for perceptions of policymaker's scientific knowledge. There was a sense at this level that elected officials likely had the least amount of knowledge about the science of coastal restoration, if they were even aware of the coastal erosion problem in Louisiana at all. The Louisiana Congressional delegation was seen as having the most knowledge, roughly about the same as elected state-level officials, aware of the broad strokes of the science but lacking the specific details of why a restoration project works or details of the computer modeling CPRA used to produce the plan. Location was an important sub-theme under variation, with employees of federal science agencies located within the state being viewed as understanding the science well, shown with the following quote:

> "I would say just by virtue of co-location and proximity, that there's a broader, better understanding of the issues and the science with federal folks who are that are regional as opposed to national."

Sediment diversions were the exception, no one was seen as an expert at this level due to the understanding that diversions are a relatively new project type as compared to the other project types listed in the Master Plan.

Another overlap between the state and federal level in figure 6.2 deals with navigation issues. Louisiana and the federal government have a long history of working together on navigation issues due to the state containing the mouth of the Mississippi River, historically a major artery of commerce dating back to the very beginning of European colonization. The Army Corps of Engineers (USACE) was considered by some to be the only agency incorporating navigation interests in their coastal restoration work as CPRA is viewed to be not engaging with the industry. While CPRA has formed a navigation focus group for both iterations of the master plan, the agency was considered by some to be silent on how restoration projects, or the lack restoration projects, will affect the navigation industry along the river. According to interviewees, CPRA is not planning any restoration projects down river from the Port Sulphur, LA, essentially abandoning the current mouth of the river, the well-known bird's foot delta. As an interviewee indicated,

> "They've [CPRA] kinda given up on that so to speak, and that's been a bone of contention because the mouth of the river is the life blood of the economy and the whole argument for coastal restoration is that Louisiana is a working coast and it has this huge economic benefit to the state, to the nation, and to the world in many aspects. And then, when we're talking about the projects that are moving forward, they don't take into account some of the areas that support that economy."

This could be the beginnings of a significant conflict with the master plan as those in the navigation industry could leap-frog the state to work more directly with the familiar partner of the USACE to maintain current navigation channels, to the potential detriment of Louisiana's restoration efforts if those conflict with those of the USACE.

At the federal level, interviewees frequently named United States Representative Garret Graves from Louisiana's 6th District as well as the five federal agencies, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture Natural Resources Conservation Service, and the NOAA National Marine Fisheries, that have been involved with coastal restoration work in Louisiana through the CWPPRA program. Given the CWPPRA program's successful multi decade long history it is not surprising that those agencies were viewed as having a good grasp of the science. U.S. Representative Graves was a surprising choice because though he served for six years as the Executive Director for the CPRA before successfully running for Congress, during his tenure at CPRA he expressed viewpoints similar to those of the climate change-denier community in regard to the expected rate of sea-level rise. The rest of the Louisiana Congressional delegation was also felt to have at least a basic grasp of the science as they were often required to defend the state's requests for financial resources for the plan. Other federal agencies mentioned for having a good grasp of the science include The Gulf Coast Ecosystem Restoration Council and the U.S. Geological Survey.

**Adaptive Management and the Coastal Master Plan**

The authors of the Master Plan were aware of the some of the scientific uncertainties embedded in the plan due to the complex interactions of the different restoration projects and the various uses of Louisiana's working coast. Their strategy to deal with this uncertainty was to design and employ an adaptive management framework with the master plan to help address uncertainties as they arise with projects and to incorporate new scientific knowledge into future

restoration efforts (CPRA 2012). Adaptive management is often proposed by policy makers to deal with scientific uncertainties and environmental projects (Balint et al. 2011; Allen and Gunderson 2011).

The adaptive management framework was not developed by the time the 2012 Plan was published and authorized, so the state indicated that developing it would be a priority during the early period of implementation of the 2012 Plan. Figure 6.3 shows the model of the adaptive management framework at the time of publication for the 2012 Plan. The general plan indicated that the yet-to be developed adaptive management framework would link all of the components of coastal program together and that this would lead to more successful implementation of the Master Plan. The 2012 Master Plan forecasted the development of the adaptive management framework for 2012-2013 (CPRA 2012). Figures 6.4 and 6.5 show the adaptive management framework CPRA developed for the 2017 iteration of the plan. Figure 6.4 shows the adaptive management at the plan level, how new knowledge and learning about the ecosystem as a whole will be incorporated into the plan. Figure 6.5 shows the framework at the project level, which appears to line up with the adaptive management framework presented in figure 2.1 (the general framework figure). Of concern is how CPRA is defining active and passive adaptive management, definitions of which that do not correspond with the accepted definitions in the peer-reviewed literature. According CPRA, 'active' adaptive management is defined as being in use when a project has operation requirements that involve continual human assessment (CPRA 2017). The Davis Pond Freshwater Diversion was held up as an example of this type of adaptive management in action (CPRA 2017). 'Passive' adaptive management, on the other hand, is used when projects do not require human involvement in their operations, such as with the Lake

Hermitage Marsh Creation project that was completed in 2015 (CPRA 2017). It is unclear what the source of these different conceptual definitions is, but it may be rooted in a desire to give the appearance that the state is taking an "active" role in the management of projects like the planned sediment diversions since the word passive typically has less than positive connotations. In spite of how CPRA has defined active and passive adaptive management, it appears from the 2017 Coastal Master Plan (CPRA 2017) and a report published by The Restore the Mississippi River Delta Team (Peyronnin et al. 2016), that Louisiana will be implementing a passive adaptive management strategy, as defined by the peer-reviewed literature, for sediment diversions.

Given these definitional issues with CPRA, in order to understand how stakeholders understood the concept of adaptive management I asked them to define it. All of the interviewees defined adaptive management in line with the concept of passive adaptive management from the peer-reviewed literature, which involves formulating predictive models, implementing projects based on the model information, and then revising the models and projects as monitoring data becomes available (see Figure 2.3). Experimentation, as would be expected in active adaptive management, was not included in their definitions of the concept. Interviewees did not seem to be aware of the two variations of adaptive management. Interviewees described monitoring a project and with that information then adapting the management of the project to make it more successful if needed. The following are two examples of this understanding:

> "Adaptive management is after you build a restoration project to monitor that project and see how it's working and if it is not working as well as you would like make some adjustments to make it work according to the original objectives. For example, a marsh creation, a marsh restoration project, using dredge material, for example if you monitor it

and find out that one half of the area is lower than you would like, then adaptive management would be to put some more sediment into that one half to bring the elevation up so that it will grow the emerging vegetation."

"So in my own words, adaptive management is the identification of goals and objectives, the implementation of actions to achieve those goals and objectives, analysis of data that assesses the action's ability to meet those goals and objectives. And then, reconsideration of implementation and changing of the action to help further improve the action's abilities to meet those goals and objectives."

A few stakeholders felt that Louisiana has historically been utilizing an adaptive management framework, as shown by the following:

"To be perfectly honest, I think adaptive management is kind of largely a buzz word and the coastal dynamics in Louisiana are so complex and the environment is changing so rapidly that we've been adaptively managing operations and projects since we started building projects without really calling it adaptive management."

Despite what these stakeholders may feel, Louisiana has not been employing an adaptive management approach with previously constructed restoration projects. For most of those past projects, including those mentioned by interviewees, trial-and-error was the approach for learning.

A vital component of adaptive management is monitoring. Without a comprehensive monitoring design it is incredibly difficult to assess changes, if any, that have occurred after a management strategy has been implemented. Roughly half of the interviewees were familiar with Louisiana's Coastwide Reference Monitoring System (CRMS) (figure 6.6) and referenced it

when asked if they were aware of any project monitoring occurring. Only a few knew of individual project monitoring outside of CRMS, indicating that the federal sponsor that constructed a project usually monitored said project for some period of time after construction. According to one interviewee,

> "I feel good about monitoring with the CWPPRA Program but I don't think the state is monitoring for their, we call them State Owner Projects, projects that are funded with state dollars that they get from another source, so if the state is generally very poor and even state-only dollars is down from, you know, through the Deepwater Horizon oil spill money, stuff like that."

Despite CRMS, which provides a widespread overview of the state of the coast, this potential lack of targeted monitoring for state-only projects, ones where there is not a federal partner, may be a concerning deficiency of the implementation of the master plan as it difficult then to determine any potential consequences of a particular project.

Continuing at the project level, the lack of a single funding source for the entirety of the plan was perceived to be an impediment to adaptive management. Each project may have a different funding source, and with it different requirements about how money can and/or cannot be spent, which could make it difficult to adaptively manage projects. One interviewee believed that the state had been more successful at implementing adaptive management at the project level, but they appeared to be confusing adaptive management with trial-and-error learning, as seen with the following quote:

> "I think we've done a reasonable job on the state side of inadvertently implementing an adaptive management framework at the project level, the project type level. The work

> that we've done, particularly on things like marsh creation, barrier island restoration, where we have a wealth of experience and a wealth of data relative to particularly the physical aspects of those restoration projects … So I think we all knew that we would do something, we would measure our success or failures of that relative to our expectation, and then we would incorporate that into the next project. And we did the same types of projects over and over and over again, but not just us as planners and managers of implementation, but particularly the private sector designers that were pretty invested in making sure that the project that they were tying their selves to was a success as individuals."

This demonstrates another facet of the misunderstanding present in this space about what adaptive management actually is. Multiple interviewees indicated that sediment diversions were the only type of project adaptive management was needed for as they were deemed more complex than previous restoration projects and due to a lack of experience in Louisiana with this project type. Unexpected surprises with how a restoration project operates or how it interacts with the local environment may occur with any of the constructed projects given the many unanswered or partially answered questions around rebuilding the coastal ecosystem. By limiting adaptive management activities solely to sediment diversions one loses the strength of adaptive management in learning from the those surprises and incorporating that learning into the overall implementation of the plan.

Stakeholders had a sense of what defined project successes and project failures, but the view of success or failure did not correspond to success and failure in the experiment sense. Projects viewed as successes were typically ones that made it from the planning stage, through

implementation, and had actually created/restored coastal marsh or land. Even when interviewees spoke of failures they still appeared to be describing successes as they understood it because projects had been implemented and failed. Examples provided included early terrace projects that sank, unsuccessful marsh restoration projects, barrier island protections that sank, and were altered to incorporate this new information. True project failures were projects that were not implemented at all, either due to lack of immediate funding or due to the project costs being updated for inflation or otherwise changed and were now considered too expensive for the benefits they were forecasted to accrue according to a cost-benefit analysis. Two stakeholders also defined a type of project failure, that certain projects were incorporated into the master plan based on political necessity rather than science. Each stakeholder defined this failure differently, one that projects located in certain parishes were included to get votes from those parishes on approving the overall plan. The other stakeholder ascribed the failure to an attempt to de-politicize the process of project selection through the creation of computer models that would assess how much land and at what cost each project would create. As the stakeholder viewed it,

> "I think that the idea behind that was to get people and politics out of the decision making. And the idea was let's have a science-based, let's develop this unassailable, "hey, the models tell us this is the cheapest way to build the most land." And they invented a computer model that would give them that answer. And so that was the goal, is to make it sort of the "science says this" and take the politics out of the decision making because obviously people are going to want, "hey, I want my project here, hey I want my project there." Well, the computer model is going to tell you which one has more value. But here's the downside: the model sees all land as equal. And so the model doesn't care if

> you build 1,000 acres here or there. Whereas in reality, on the landscape, 1,000 acres in one place might have more storm protection benefits to a coastal community. Or it might be holding a deteriorating land bridge together that might otherwise become open water, compared to 1,000 acres somewhere else which may be nowhere near a community and not really have a functional storm mitigation value for that community. So to me, you need a human to decide, well, 1,000 acres here is actually better than 1,000 acres there. Even though the computer model might see them as exactly the same. And the computer model's just going to pit whichever project was cheaper for the same amount of land. But in their effort to have a transparent process, I think they missed something really important."

The stakeholder viewed the planning model as insufficient for selecting projects as it was not incorporating the context, in this case the landscape, a project would be constructed in and how said project would affect that landscape. This individual did not name any specific projects that they felt exemplified this type of failure, but they strongly felt it was present in the master plan.

**Sediment Diversions**

Sediment diversions were a common theme that most interviewees mentioned in some capacity, with some supporting the planned projects and others being more cautious. As mentioned previously, several interviewees felt sediment diversions were a project type that would benefit from adaptive management as they transitioned from the planning stage to implementation. This is a view held by multiple national and local environmental NGOs, including the Audubon Society, the Environmental Defense Fund, the Coalition to Restore

Coastal Louisiana, and the Lake Pontchartrain Basin Foundation, as seen with the publication of a 2016 report that provided expert recommendations for the operation and adaptive management of one of the planned diversions, the Mid-Barataria Sediment Diversion near Myrtle Grove, Louisiana (see Peyronnin et al. 2016). Sub-themes related to the sediment diversions dealt with uncertainty, the public conflict, and potential social/political change, figure 6.7. There is awareness that the sediment diversions are uncertain and untested in that the evidence suggesting they will be successful in building wetlands is the computer modeling work completed by CPRA, but others expressed faith that the diversions would work based on marsh creation they had personally observed at locations like the Wax Lake Outlet and the existing salinity diversions at Caernarvon and Davis Pond. There was also a strong awareness that the sediment diversions are controversial due to their likely impact on fishermen and oystermen who harvest in the planned diversion vicinity.

The third sub-theme involved stakeholders' concerns that the possibility of future social/ political changes also needed to be considered during the planning and design of the diversions. Political changes in the state government were felt to be a concern if operational diversions did not produce land as fast as models forecasted, it may be difficult to persuade the state, and the public, to continue paying to operate them. As one stakeholder put it best,

> "Just because this current administration believes that a diversion, as an example, is the best thing to do, what happens if 10 years from now another governor comes in and says, man, I don't want to spend the $25 million a year I'm spending down there for operations and maintenance? And so instead of doing all of that, and plus I'm not building that much land right now, it's not doing much, we're just going to shut it down. So you're looking at

political will I think is a huge issue, that's going to vary from administration to administration."

Another stakeholder mentioned a different component of this theme, the long timescales involved with congressional authorization and funding for projects involving the USACE, in part due to different administrations' view of what USACE projects to fund. The changes in political climate and operational needs of the Davis Pond Salinity Diversion were mentioned with this theme in that it took 30 years for this particular project to go from design to operation.

How stakeholders' define project failure and their hazy definition of adaptive management are problematic for the long-term success of the proposed sediment diversions, the main restoration tool of the 2012 Coastal Master Plan. The proposed sediment diversions are on a much larger scale and complexity than any of the projects the state has participated in building or operating before, large enough that it may not be possible to learn from the diversions through the passive adaptive management or trial-and-error processes many stakeholders are familiar with. This is especially true if the sediment diversions are operated with strict data targets that must be met, as the Caernarvon and Davis Pond Freshwater Diversions currently are with respect to salinity. Operational sediment diversions could contribute to valuable knowledge to current areas of scientific uncertainty, such as the effects of excess nitrogen on marshes created by the diversion, but that knowledge may not be welcome if it shows the diversions to cause more harm than benefit to the ecosystem. The conception of failure being a project not implemented could result in the state pushing forward with implementing and operating diversions, even if information learned from operation shows the diversions are not working as forecasted, solely to be able to claim they were successful through implementation. Constructing sediment diversions

would also allow the state leaders to claim that they were successful in doing "something" to address the problem of coastal erosion.

**Uncertainties with the Coastal Master Plan**

Participants were asked directly, given all the uncertainties with the Master Plan, which area, political, financial, or scientific, needed to be answered first in order for the Master Plan to be successful. They were evenly divided over which area was the most important, with roughly one-third selecting each of the three areas. Most recognized that all three were important to be addressed for the plan's long-term success and a few felt all three areas need to be addressed at more or less the same time for plan success. Several of those that selected financial or political uncertainty as the most important area to solve did so because they felt the scientific uncertainties were small, as shown with the following:

> "We've done world class work on science. We've had the best models, we've had the best engineering, it's incredible how much work has come out of the state. I can't imagine anybody in the world has come up with anything better than what we've done here. It's probably largely known within the state the quality of work that's been done here. I don't think that's ever going to be a real big problem. You can only go so far on the science too, and it's really just trying to feel fairly confident that what you're doing is going to work and then adaptively manage like we talked early."

Others picked the scientific uncertainty with the belief that leading with the science would drive policymaking,

> "So to me, when we lead with the science that makes it harder for the political part to negatively affect and when we lead with the science that helps us to make a better case for the funding as well."

Science policy literature and hard-earned environmental policy experience have shown that reducing scientific uncertainty does not lead to better or clearer policy decision making. There is enough scientific uncertainty involved with the plan that trying to "lead" with the science could result in significant implementation delays if those against some or all of the plan argue for greater certainty, a tactic that has been used very successfully by the oil and gas industry and their proxies in regard to action of climate change.

The 2012 Master Plan was a fairly optimistic document, presenting an attractive and understood to be science-based case for the state of Louisiana to be able to reverse the coastal erosion rates the state was experiencing and, by the end of the fifty year study period, actually have a net land gain due to the restoration projects in the plan (CPRA 2012). It was possible a non-scientist layman reading the plan could have the impression that the state understood the science well and just needed to find funding for the plan to be successful. Given this possible discrepancy between perception and reality, I wanted to investigate what uncertainties related to the plan stakeholders felt could lead to the public losing faith with this effort. While a majority of the interviewees agreed that there were uncertainties that could lead to a loss of faith, a minority, 31%, disagreed with the question, indicating they did not feel the public could misread the plan in such a fashion. The reasons why stakeholders thought the public could lose faith in the plan include funding issues, the randomness of the weather, and public difficulties understanding the modeling efforts that underscore the plan itself.

There were several facets to funding issues related to the master plan potentially causing a loss of faith in the plan. With the state's difficulties in funding the plan already well documented, some stakeholders felt people will lose faith in the plan if not enough of the listed projects are built in a time frame that will help reduce the flood risks the public is already facing. Essentially, it would be hard to have faith in a plan that is never put into action. Others felt loss of faith could occur if the state did have the money to implement the plan, did invest the billions of dollars needed to build and operate the planned projects, and residents were continued to experience severe flooding due to hurricanes due to the slow time scales involved with some restoration projects. They felt it could appear to the public that the state is investing billions of dollars in coastal restoration and yet they are no better off than before. Loss of faith in the master plan could occur whether or not the state manages to secure the funding need to implement it, with a few stakeholders indicating this loss of faith was already occurring. People are already moving from frequently flooded areas of the southern parishes because they can no longer afford to live there. According to one stakeholder with this view,

> "And the problem is, the flood insurance in some of these areas is so expensive you cannot [buy flood insurance]. And what's naturally happening is that, if you're trying to build a house in areas of St. Mary, Terrebonne Parish is on the coast, the bank has to have proof that you were buying flood insurance before they'll give you a loan. The flood insurance has been skyrocketing to the point where they can't afford it. So if you can't afford it, you can't build. So natural selection is starting to occur right now."

Weather uncertainties were a strong theme that emerged that could cause public loss of faith. The vagaries of future hurricane tracks could destroy restoration projects before they had a

chance to be successful or could cause damage due to a project not being fully implemented when the storm hit. Or, as one participant indicated,

> "…by 2012 the New Orleans, what we call the HSDRRS, the Hurricane Risk Reduction, so that was pretty substantially on its way. And so what we saw was kind of that change in the way that water moved and so that hit other places differently so especially some of the River parishes that also bordered of the lake so that made water move differently and it just kind of underscored the need that maybe some folks that didn't think they needed to have protection now in fact needed it."

Completed restoration and flood protection projects could change how water moves through the ecosystem, changing the flooding landscape during a rain event in ways some may not be prepared for when they expected the plan to resolve these problems, possibly leading to public distrust of the plan.

The final reason some stakeholders believed could result in loss of faith was potential public difficulties understanding the modeling efforts that underscore the plan itself. This includes how the cost estimates for various projects were determined as well since those were a vital component of the planning model that was used to select projects. If those cost estimates end up being too conservative for a certain project this could lead to dissension and loss of faith among those upset that other projects were excluded from the plan due to estimated costs. The different model scenarios for sea level rise could also be a point of confusion for the public in spite of research being done to reduce scientific uncertainty in the other elements of the plan. As one stakeholder described it,

> “I think certainly seeing that change and acknowledging that the biggest variable there is the uncertainty related to sea level rise and that the internal conflict faced by many people on the coast who question the science behind global warming sea level rise, yet have to face it every day. I definitely would see the evolution of a plan that at one time that said "you're going to be OK" and another plan that said "you're probably not going to be OK" could certainly cause people to lose faith.”

There has been an evolution of the sea-level rise scenarios between the 2012 and the 2017 plan, with what was considered to be the worst case scenario in the 2012 plan, 1.4 feet (0.45 meters) increase in the next 50 years, is now the absolute best case scenario for the 2017 plan (CPRA 2012; CPRA 2017). This has led CPRA to step back from the claim made in the 2012 plan that it would be possible, if the plan was funded and implemented, for overall result to be a net gain of land by the end of the 50 year period. The 2017 plan now stresses how restoration projects are needed to help maintain the wetlands currently in existence and stem the tide of financial losses from future flood events (CPRA 2017).

**Figures and Tables**

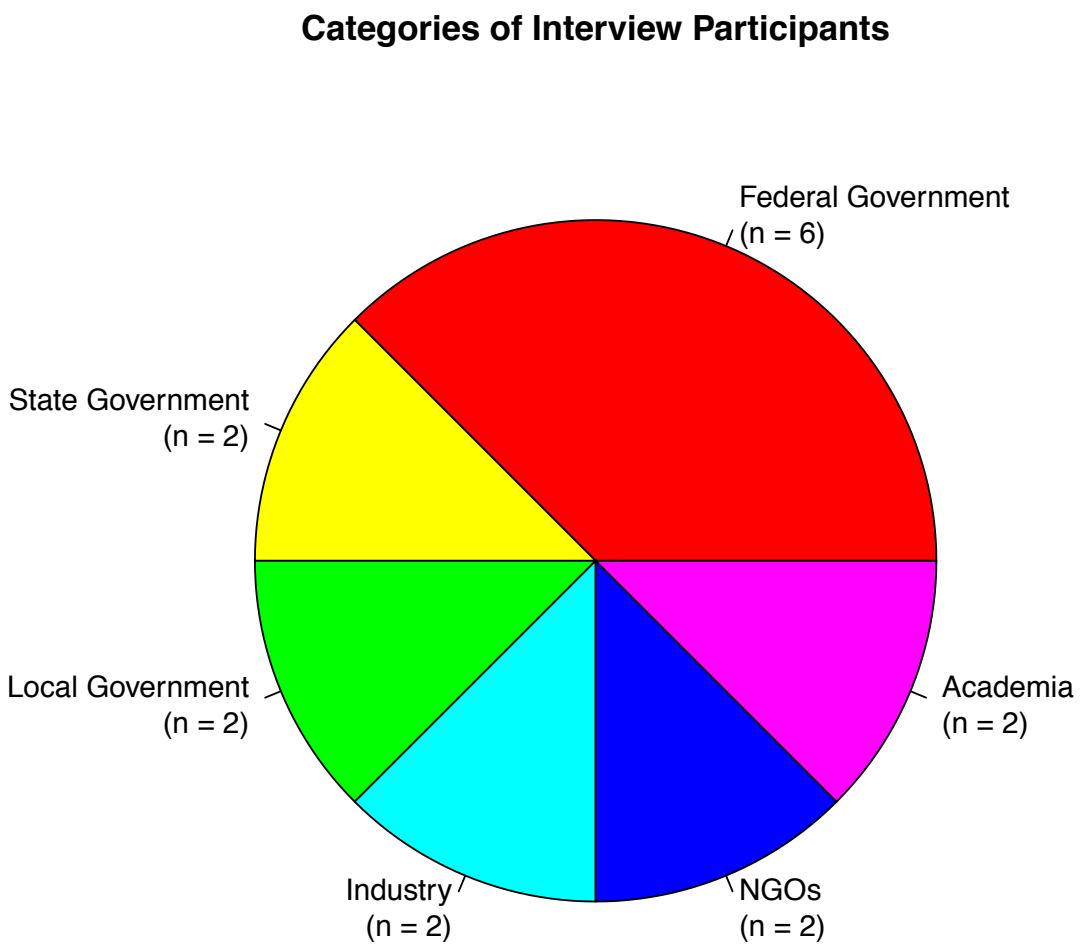


Figure 6.1: Chart showing the proportion of each stakeholder group category of the sixteen 2017 Framework Development Team participants who agreed to participate in this study.

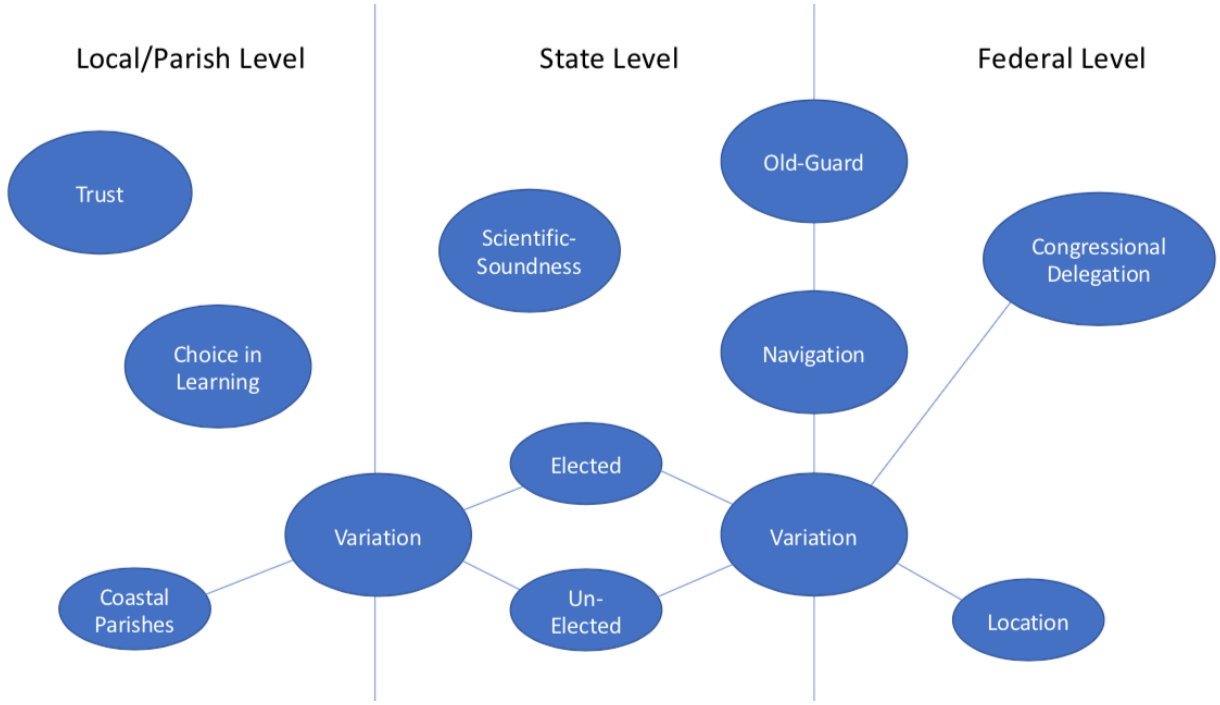


Figure 6.2: Thematic map of perceptions of scientific knowledge and understanding for all three levels of government. The three levels of government, local/parish, state, and federal, are indicated by the columns. Themes described in more than one level are situated on the line separating the two levels at which the theme occurred. Sub-themes are indicated by smaller ovals and are connected to their parent theme by a line.

| Person | Parish | Position |
|---|---|---|
| Laurie Comier | Calcasieu | Parish Coastal Zone Manager |
| Simone Maloz | Lafourche | Executive Director for Restore or Retreat, Inc. |
| Richie Blink | Plaquemines | Council Member, District 8 |
| Michael Terrell | Unknown | Unknown |
| Ryan Bourriaque | Cameron | Parish Administrator |
| Robert Spears | Plaquemines | Coastal Program Manager |
| Marnie Winter | Jefferson | Director, Parish Department of Environmental Affairs |
| Wendell Curole | Lafourche | General Manager, South Lafourche Levee District |
| Reggie Dupre | Terrebonne | Executive Director, Terrebonne Levee & Conservation District |
| Mart Black | Terrebonne | Director, Department of Coastal Restoration & Preservation |
| Gordy Dove | Terrebonne | Parish President |

Table 6.1: Local/parish level officials in southern Louisiana that were believed to have a good understanding of the science involved in the coastal master plan.


Figure 6.3: A visualization from the 2012 master plan of how CPRA expected an adaptive management framework to incorporate all the existing components of coastal restoration work, represented by the multi-colored, overlapping circles, in order for implementation of the plan to proceed in spite of the uncertainties involved (CPRA 2012).

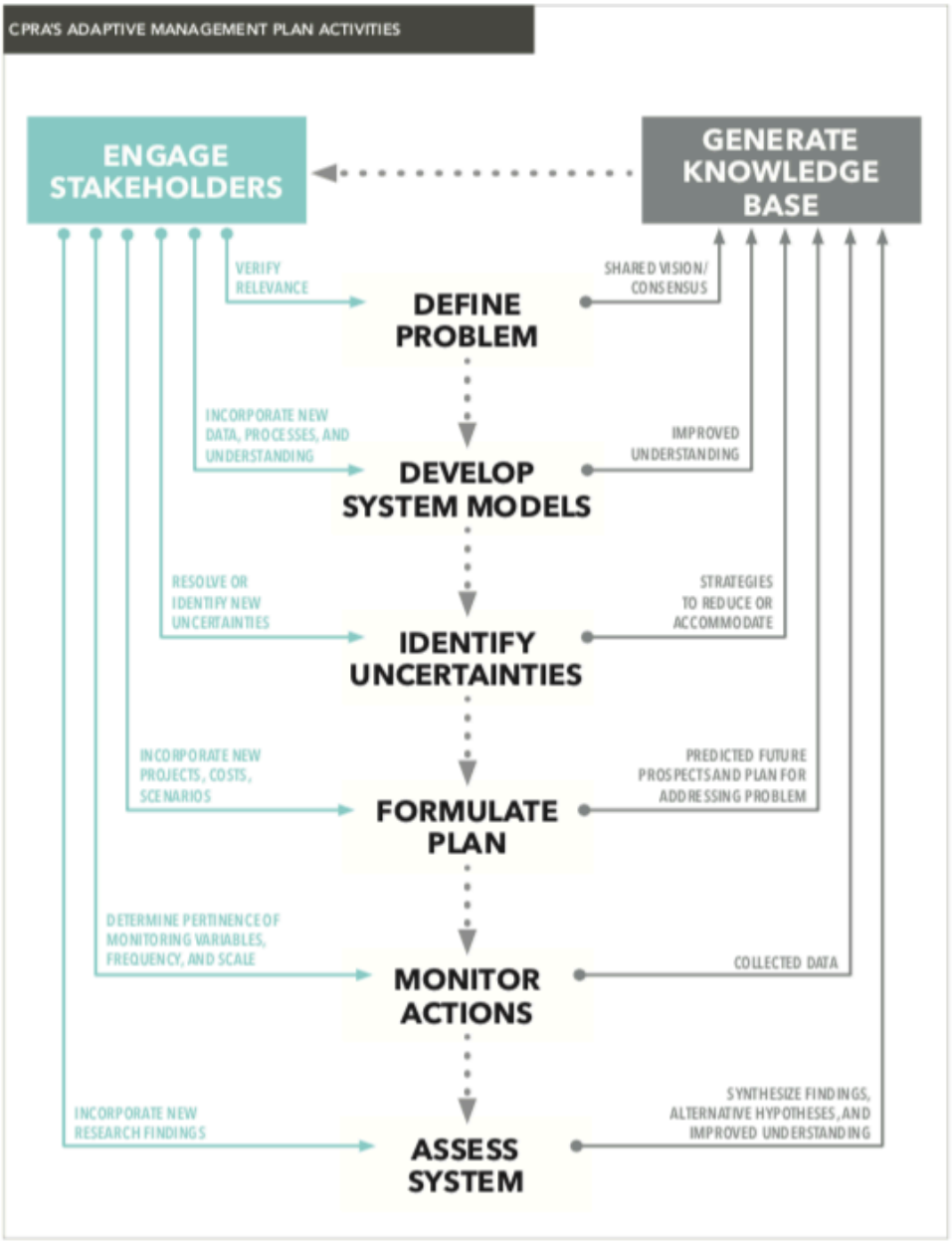


Figure 6.4: The plan-level adaptive management framework conceived by CPRA. The agency defines seven steps in their framework, shown in bold, black text, and how those steps are interconnected with stakeholder engagement and knowledge generation (CPRA 2017).

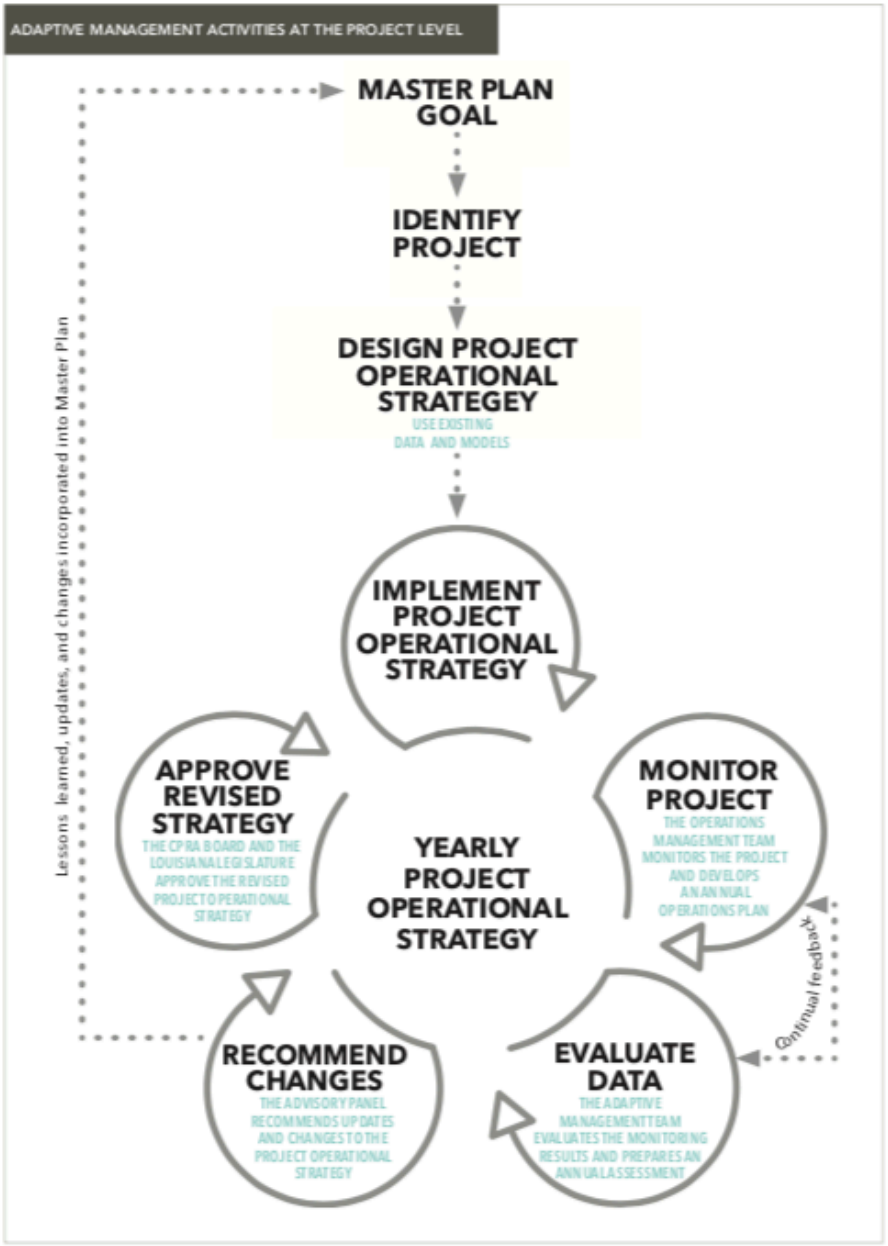


Figure 6.5: The project-level adaptive management framework conceived by CPRA (CPRA 2017).

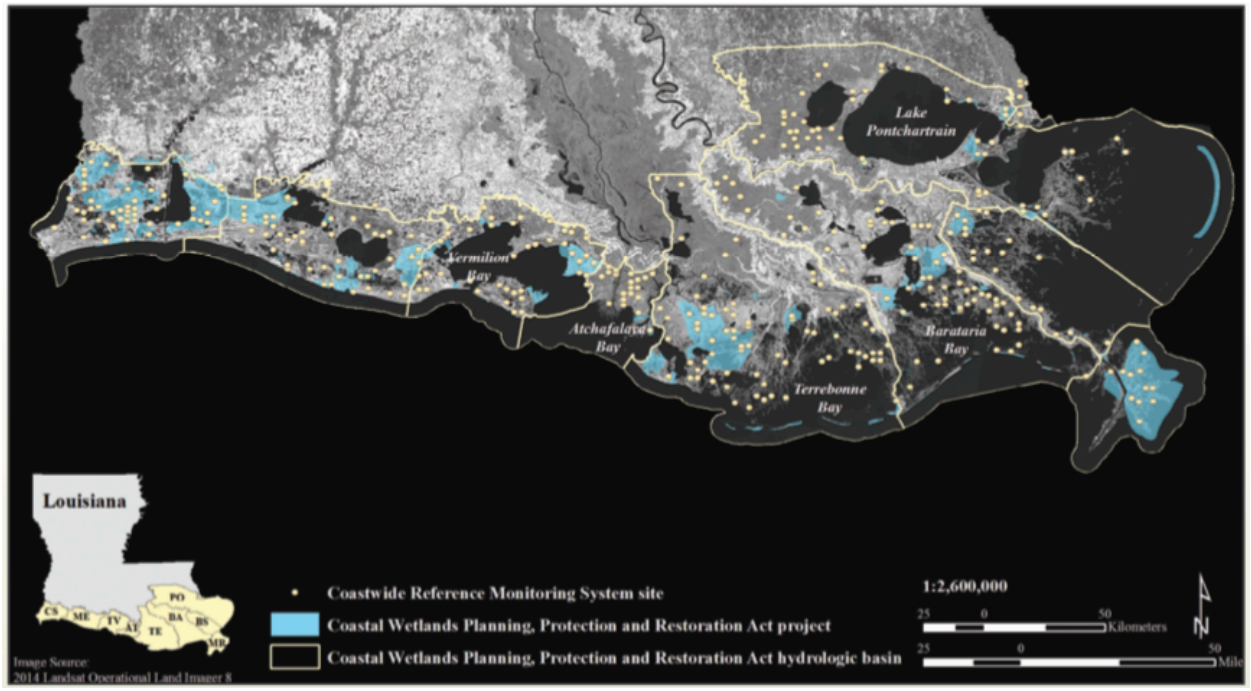


Figure 6.6: Map of the roughly 390 monitoring sites that compose Louisiana's Coastwide Reference Monitoring System (CRMS) ("Coastwide Reference Monitoring System (CRMS)")

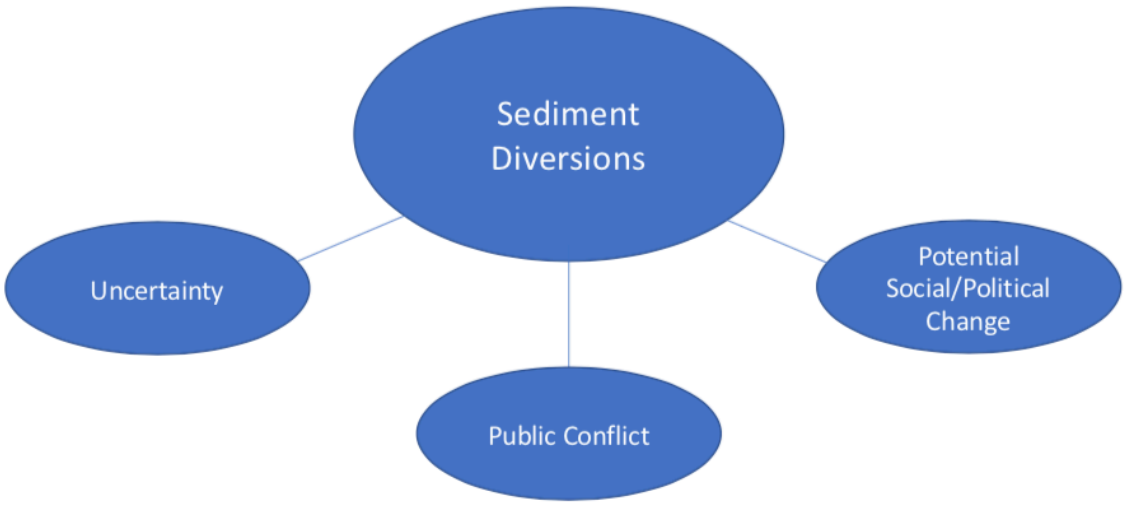


Figure 6.7: Thematic map of stakeholders' comments regarding the planned sediment diversions in the master plan.

# Chapter 7: Conclusions

The public discourse in Louisiana around the 2012 Coastal Master Plan focused more on financial/funding topics than the science that supports the plan. Within the newspaper article corpus, 59% (n = 227) of newspaper articles dealt with financial elements of the coastal master plan while 41% (n = 158) dealt with science. All the newspapers included in this study, with the exception of *The Lens*, focused more on the financial aspects of the plan. Climate change and sediment diversions were the two most frequently covered science topics with a combined 72.2% of "science" articles, with both also being areas of uncertainty for the implementation of the plan. While it is an encouraging sign that the public discourse is focusing on the areas of uncertainty, one topic where there was surprising silence was "adaptive management," with only one article in the entire corpus focusing on the subject. The Coastal Protection and Restoration Authority (CPRA) identified adaptive management as the implementation strategy they were going to use to incorporate new knowledge into the projects identified in the master plan, but this topic was not clearly defined or thoroughly discussed the way climate change and sediment diversions were. Several articles give brief acknowledgements that adaptive management will allow the plan to change as needed, but the statements were vague at best. If CPRA does not properly design and execute adaptive management plans, or if the public has unrealistic expectations of what adaptive management can actually help the master plan implement, it will likely be difficult for the master plan process to achieve success at the ambitious goal of restoring and stabilizing the wetland erosion occurring along the coast. Louisiana is poised to embark on a challenging and novel experimental project in using large, controlled sediment diversions to build land, attempting to replicate natural deltaic processes that have been disrupted due to anthropogenic influences. There are many uncertainties involved with these projects,

some already known and others that will become apparent once a sediment diversion is constructed and operational, and successful adaptive management can help facilitate learning and improved implementation and operation of future diversions. Mishandling or botching the adaptive management of the master plan will likely lead to disaster for the coastal parishes as the erosion crisis is reaching a critical juncture for residents along the coast, so the silence in the corpus on this crucial topic is problematic.

Political maneuvering at local, state, and federal government levels and the sources of funding for the master plan were the main themes that emerged from the financial portion of the corpus. The successful maneuvering/reallocation of funds that did occur, for example Jefferson Parish funneling some of the money received from BP for the parish general fund, combined with the attempts to do so and the state's history, shows there is reason for people to be concerned about the misuse of restoration funds as some Louisiana politicians are still not taking the coastal erosion crisis seriously, or that the federal government is unlikely to foot the bill, even as the crisis begins reaching an existential level.

Surprisingly given the conservative political representation of the state and the domination of the oil and gas industry in state and local politics, climate change was not covered as a particularly controversial topic in the local newspapers. While not covered as much as sediment diversions were, climate change and sea-level rise were the second most covered science topics in the corpus with 21 articles. Most of those articles acknowledged that it was occurring either due to direct observation of the changes to the coast or through scientific research and agreed that the state, and CPRA, needed to take climate change seriously. This was especially true of articles published towards the end of the study period as thoughts began to turn

towards how to update the master plan for its 2017 iteration. There was only a brief conflict around one aspect of climate change, the forecasted total relative sea-level rise rate for coastal Louisiana in the coming decades. New data were published that contradicted even the worst case estimate of expected sea-level rise in the 2012 master plan, and the head of CPRA's response was to argue that the data must be incorrect. This conflict ultimately though was short lived as the main instigator, the head of CPRA, resigned his position to make a successful run for the U.S. House of Representatives. This resulted in new leadership at CPRA who were more accepting of this updated scientific information.

Sediment diversions, on the other hand, were a very controversial topic in the newspapers, with both the 'for' and 'against' factions arguing that scientific research supports their position. Many fisherman and oystermen have taken a negative view on the proposed effectiveness of the sediment diversions because they believe the freshwater from diversions will too drastically change the salinity of their fishing and harvesting grounds. They vehemently argued against the diversions because they believe their values, to be able to continue their way of life and support their families, are not being considered by the officials involved with the coastal master planning process. Many of the proponents for the diversions argue that the problem of coastal erosion has gotten so bad that the proposed diversions are the only option to halt the land/marsh loss. This assumption is based on the output of computer modeling simulations designed to replicate the expected behavior of the Mississippi River with diversions, simulations that were based on data from the 1960s.

A lack of meta-analyses to truly determine if the existing freshwater diversions are actually building sustainable land has led to many assumptions being made on how the proposed

sediment diversions will work once constructed. Louisiana has a previous history of building large environmental projects based on assumptions about their benefits or environmental impacts, and not conducting evaluations to determine the veracity of these assumptions, i.e., the Mississippi River Gulf Outlet, the decision to allow numerous canals to be dredged throughout the coastal wetlands for oil and gas exploration, until it is far too late to adjust course if needed. This is the crux of the concerns raised by the "against" faction: that too many assumptions are being made about the benefits of the controlled sediment diversions, and if those assumptions are incorrect, by the time that would be conclusively known it would be too late to repair the damage, thus ruining their livelihoods without any benefit to the coast.

Conversely, there is a strong determination at the state level that Louisiana must be seen as doing something to address coastal erosion, and after the major flood damage caused by the hurricanes of 2005, that something would need to be "big." This demonstrates flawed thinking in that just because a problem is "big," it does not follow that the best solution is necessarily "big" as well. There are other options for coastal restoration, such as the canal backfilling mentioned in Chapter 1, that are cheaper and effective in restoring wetlands, potentially making them better choices given the limited sources of funding the state actually has available to it. The focus on the "big" solution of the controlled sediment diversions may serve an alternate purpose as well, as a distraction from the politically unpleasant task of holding the oil and gas industry accountable for the damage they have caused in the coastal wetlands of the state as well as the damage they continue to cause through contributions to our changing climate.

The discourse around sources of funding centered on uncertainty, with roughly half the articles, 54.2%, discussing uncertain sources of funding that could be promising in the future.

Coverage of uncertain funding increased to 70.9% when articles discussing funding uncertainty related to the Deepwater Horizon Oil Spill are included. This indicates that the state government is very aware of the lack of funding in its possession for 2012 master plan projects, and was attempting to show that it was actively seeking out sources of funding. Several potential sources of funding were suggested, such as creating a market place of carbon credits, but none were proven capable of generating the billions of dollars needed during the study period. It is worth further study to see if any of these ideas are further developed in Louisiana into reliable, reoccurring sources of funding or if policy changes such as the introduction of a coastal levy are made to create funding, or, as the state has done in the past with large projects like the levee system, if Louisiana continues to put all its efforts into securing federal funding for restoration.

That state received a large of amount of money, roughly $7 billion, from BP as a result of the company's culpability in the Deepwater Horizon Oil Spill, but this is a one-time windfall caused by a disaster that also greatly damaged the very same coastal wetlands the state is attempting to restore. The Louisiana congressional delegation was not able to draw federal legislative attention restoring the coast during the study period, though that may have been due to the expectation in Congress that Louisiana would shortly be receiving billions of dollars from BP so further federal action/funding would not be needed. Threaded throughout the discussions about the lack of funding is the intense awareness that the state cannot be seen as misusing the funds for coastal restoration it does receive, as shown with the 26.3% of political maneuvering articles warning state leaders of such. Tied to the requirements for successful implementation of the 2012 plan is the recognition that Louisiana must overcome, or at least appear to overcome, its

history as a financially corrupt state in order to have a chance to secure federal funding. How the state uses the money it will receive from BP will be its chance to prove it.

From the stakeholder interviews, several points came to the fore: that CPRA is the main driver of coastal restoration science, that there are fundamental issues around the state's implementation of adaptive management thus far, and that the scientific and financial uncertainties are viewed as intertwined. CPRA is leading both the planning and coastal restoration research efforts with state legislators thus far uncritically supporting the plan iterations. Scientific knowledge of the concepts discussed in the plan is sparse outside of CPRA and the regional representatives of the five federal agencies that have been involved in restoration work in Louisiana as part the CWPPRA program. CPRA does hold presentations around the state about the plan and its components, but according to some stakeholders most of those in the audience only understand the basics of the processes being described, even less about the details of the models trying to imitate and forecast the land-building behavior of restoration projects, making it difficult for local policy makers to evaluate the merits of the plan. Only a handful of people across the different parishes were identified as understanding the science of the plan well (table 6.1), and while some stakeholders felt those listed were serving as unofficial representatives of their parishes in regard to the science, there is likely too few of them to push back against or critique elements of the plan effectively. An example of this is Plaquemines Parish, where despite local officials being highly critical of the planned sediment diversions in their parish, CPRA and the state are moving forward with the Mid-Barataria and Mid-Breton Diversions.

There are fundamental issues around the state's implementation of adaptive management thus far, and these issues will likely worsen as the state moves forward with the sediment diversions. There was no inclusion of experimentation to reduce uncertainty, a key component, with any of the stakeholder's conceptions of adaptive management, and indeed with some it is likely that they view the term "adaptive management" as the new label for the trial-and-error approach that has been going on for decades in Louisiana coastal restoration work. There is a vague impression from both stakeholders and in the newspaper articles that adaptive management will "deal" with any uncertainty that may arise during the implementation of the master plan, but there does not appear to be a detailed idea of what that would look like. Given Louisiana's history with being slow to react to environmental issues, and when pushed to react the state's efforts to maintain the status quo with the oil and gas industry, this vagueness around adaptive management may be an intentional action to allow for a business-as-usual approach to continue with restoration projects.

Strengthening this argument is the opinion from stakeholders that adaptive management was only truly needed with the planned sediment diversions, due to this being an untried and untested project type for the region, despite the multitude of other project types being constructed. This gives the impression that the stakeholders feel that there is little learning that could occur, that all is known with those other projects. Thus far, it does not appear CPRA has implemented their adaptive management framework with any projects individually, and while an external group of scientists developed a brief report on potential operational and adaptive management of the proposed Mid-Barataria Sediment Diversion (see Peyronnin et al. 2016), the report is truly more of a first attempt at developing an operational management plan. Project

failures are seen as ones that are not implemented so there is not true experimental learning from restoration projects occurring; project operations are simply adjusted in some way for a project to be deemed a success. Monitoring is occurring at a broad scale across the coast with the CRMS, but beyond that individual project monitoring is disorganized or non-existent. All these point to a continuation so far of the status quo when it comes to how Louisiana implements coastal restoration, despite the state attempting to manage and re-tool the entire ecosystem of the Mississippi River Delta.

Given the values-based conflict cloaked in science reported in newspapers and known to the stakeholders, as well as the issues thus far with understanding and implementing an adaptive management framework, it is unlikely the planned sediment diversions will even be constructed despite the state already having the money from the BP Oil Spill fines to build them. Fishermen and oystermen interest groups are already threatening legal action on the Environmental Impact Statement (EIS), a process that has not yet started, so tempers are running high and a protracted legal fight is developing. Adaptive management is an academic concept that is not translating well into practice in Louisiana, either through honest misunderstanding or intentional misdirection, but is being held up as a panacea to prevent potential lawsuits. Of the project characteristics described by Allen and Gunderson (2011) (Table 2.2) as being present when adaptive management results in failure, several are present in relation to sediment diversions, including lack of stakeholder agreement/engagement and experiments being difficult, with a strong likelihood as of this writing that learning will not be used to modify policy or management. This supports the finding that adaptive management, and the sediment diversions, will likely not be the miraculous fix for which some are hoping.

Overall, Louisiana and CPRA do not appear to be learning any lessons from other large geographic scale adaptive management examples, such as the restoration of the Florida Everglades or the Missouri River Recovery Program. Scientists serving on The Expert Panel on Diversion Planning and Implementation, organized by The Water Institute of the Gulf, made several recommendations in their latter reports from 2015 through 2016 in line with those lessons already identified as important for adaptive management success in LoSchiavo et al.'s (2013) work on the Comprehensive Everglades Restoration Plan (CERP) Collaborative Adaptive Management Program, namely establishing an adaptive management authority, integrating adaptive management into the institutional framework, and establishing robust peer-review mechanisms. LoSchiavo et al's (2013) paper specifically describes itself as presenting lessons learned from working for over a decade to implement adaptive management in Everglades restoration work and whose authors come from the agencies directly involved with that work, including the USACE, U.S. Geological Survey, the South Florida Water Management District, and the Everglades National Park to name a few. Establishing an adaptive management authority refers to working with all the agencies and managers involved to get them on board with using an adaptive management framework, which typically necessitates changing their current trial-and-error approach, and committing the additional resources needed for framework implementation. Integrating adaptive management into the institutional framework describes clearly defining and assigning the roles and responsibilities needed for adaptive management implementation for project construction/delivery teams. CPRA has maintained a relatively in-house approach when it comes to peer-review of the scientific and modeling efforts used to develop the master plan, which has not engendered trust in those suspicious of the sediment

diversions. Likely as a result of the controversial nature of the sediment diversions, there has been some limited outside peer-review of the sediment diversion science (see Teal et al. 2012; Wells et al. 2014a; Wells et al. 2014b; Wells et al. 2015a; Wells et al. 2015b; Wells et al. 2015c; Wells et al. 2016a; Wells et al. 2016b). Other restoration project types included in the plan, and that have not generated controversy, have not experienced similar external peer-review from CPRA despite projects being completed during the time period the 2012 plan was in effect. CPRA has been publishing operation and monitoring reports on projects, but stakeholders do not seem to be aware of them. It is debatable if any adaptive management has actually occurred thus far, much less any outside peer-review.

Another key lesson from the restoration work in the Everglades and on the Missouri River is the importance of including stakeholders and the public meaningfully in the process from the very beginning, especially as operation and monitoring plans are being developed. Increased stakeholder involvement and public outreach were also recommended by The Expert Panel on Diversion Planning and Implementation. Outreach and engagement conducted by CPRA was highly technical in nature, with presentations by CPRA scientists going into detail about modeling or science research with many in the audience struggling to follow. Engagement flows one way, from CPRA to the public, instead of a two-way process recommended by those who have successfully engaged in adaptive management implementation. Many stakeholders' concerns with sediment diversions in Louisiana align with current areas on scientific uncertainty, and by limiting their involvement in adaptive management process CPRA is setting the stage for a potentially expensive and protracted legal battle.

Financial and scientific uncertainty were viewed as intertwined by stakeholders; you cannot address one without truly addressing the other. Funding for the master plan was viewed as a bit of a double-edged sword for CPRA and the plan itself; if the state has the funds to implement projects but the science is incomplete it could lead to loss of faith in the planning process. Conversely, if the state never secures the money to the build and/or operate plan projects then the erosion situation never improves, leading to loss of faith. This latter situation has occurred with previous restoration plans in Louisiana, including *The Louisiana Coastal Wetlands Restoration Plan* of 1993 and the *Coast 2050: Toward a Sustainable Coastal Louisiana* in 1998. Louisiana is in the unusual position in that it actually has, or will have shortly as of this writing, the funds to construct at least one of the keystone components of the master plan, the sediment diversions, as a result of the BP Oil Spill.

Those funds are a one-time windfall though, and, due to the uncertainty that the state can secure the remaining billions needed for the plan, there is considerable pressure on Louisiana to get the most restoration impact from that money as possible. Some stakeholders raised concerns that sediment diversions may not be the best use of those funds due to the scientific uncertainty around the diversions. They felt more targeted scientific research was needed to reduce or resolve uncertainties associated with the diversions before implementation should move forward. That same scientific uncertainty is at the root of the controversy around the diversions, captured in the qualitative content analysis of local newspaper coverage of the master plan, and could lead to costly legal challenges as CPRA moves forward with the projects. Louisiana is essentially in a position where financial uncertainty has been reduced due to the oil spill money, but the scientific uncertainty could still sidetrack the plan. This outlines the catch-22 type situation the

state of Louisiana, and likely others, will face in the future due to the impacts of climate change: financial uncertainty needs to be reduced for funds to be available to tackle scientific uncertainty, but scientific uncertainty could result in legal challenges from those who disagree with the actions that could reduce scientific uncertainty, legal challenges that would likely result in increased financial uncertainty. This could either be through the unknown costs in responding to said legal challenges or due to uncertainty of how to allocate funds earmarked for challenged projects while the legal issues play out. This is the challenge facing Louisiana as it continues to move forward with the coastal master planning process; how it works to resolve this catch-22 will be fundamental to how successful the state's efforts are to restore the coast.

This work expands the literature on adaptive management implementation. While the number of adaptive management articles published has increased since 2000, the focus of most articles has been either theoretical or suggesting how adaptive management could be useful for certain environmental problems or types of problems (McFadden et al. 2011). Empirical studies of adaptive management implementation have been identified as much needed if the concept is to continue to be relevant (McFadden et al. 2011; Fabricius and Cundill 2014). This study aims to to answer that call. While it does not appear that CPRA has actually implemented their adaptive management framework, despite claiming otherwise, this study has identified serious issues with how the adaptive management framework is being interpreted for coastal restoration work in Louisiana. This work also applies Allen and Gunderson's (2011) list of project characteristics to understand how the seeds of potential future adaptive management problems are being sown now in Louisiana.

This work also contributes to the scholarship regarding environmental policy implementation under conditions of uncertainty, in this case a relatively new facet of the science-policy interface where interconnected scientific and financial uncertainty are present. This is an especially relevant area of scholarship as climate change impacts increase in the near future, intertwined scientific and financial uncertainty will become a more common dilemma for decision makers as resources are finite and the public demands action to solve environmental problems. The focus thus far for much of the science policy literature dealing with uncertainty has been on scientific uncertainty, such as how to communicate it effectively to decision makers, stakeholders, and/or the public or how to mitigate or implement policies when it is present. A missing element in these studies is where the resources, financial or otherwise, would come from to implement said policies and, in the process, address underlying scientific uncertainties. By studying both scientific and financial uncertainties in tandem can provide a clearer picture how policy implementation is occurring under these conditions.

## Limitations

This study is a place-based case study of large-scale environmental restoration effort. The findings of this study are not generalizable to other large-scale environmental restoration efforts as the blend of cultural, political, and scientific components involved with coastal erosion in southern Louisiana is unique to the region. Other locations will have a different blend, and a different history of dealing with a particular environmental problem.

While southern Louisiana has an active science journalism community, has shown by the newspaper coverage analyzed in this study, the corpus was not without limitations. The

newspaper articles demonstrated on overall positive tone, likely due to the intentional or unintentional boosterism of the reporters. This may have resulted in a more positive orientation in the corpus towards the master plan through either masking negative elements related to the plan, or through a lack of coverage of those elements all together. This includes potentially minimizing conflict around the master plan, the focus of several codes in the qualitative content analysis coding frame. The newspaper coverage is a proxy for public interest, and while the continued coverage during the study period indicates that there is interest from the public in the master plan, it does provide insight into how the public is perceiving the newspaper coverage, for example whether they view it as informative in regard to the coastal master plan or not.

Another limitation is caused the selection of potential interviewees. There are many other stakeholders working in southern Louisiana involved with coastal restoration that may have different perspectives than those that participated in this study. Nonetheless, coastal restoration is an intensely political endeavor within Louisiana, with the possibility of professional consequences if one breaks with the official party line, as seen with the firing of Ivor van Heerdan, the deputy director of Louisiana State University's Hurricane Center, in 2009. Dr. van Heerdan was dismissed from his position at LSU due to his vocal criticism of the performance of the USACE's levee system around the New Orleans metropolitan area during Hurricane Katrina, criticism that led state officials to conclude Dr. van Heerdan was creating enough bad press for the state that it would cause a decrease in federal funding for the recovery efforts. The Coastal Protection and Restoration Authority did not advertise how it put together the Framework Development Team, just that they had included insights and information from the team in their plan development efforts. The people that serve on the team may have been selected for reasons

that could be biasing this study in a more optimistic direction. I hoped that since those on the Framework Development Team were publicly announced as participating with CPRA they would be more willing to be interviewed about their thoughts on the master plan. As mentioned in Chapter 6, many of those who chose to participate were very concerned that their anonymity be preserved, likely hearkening back to example made of Dr. van Heerdan.

## Future Work

This study was exploratory in nature and sets up several future research projects. As mentioned in Chapter 4, the Narrative Policy Framework (NPF) was thought to be the best method of analysis at the beginning of data collection for the newspaper articles. While the NPF was not appropriate for the purposes of this study, it would be an excellent choice of method to analyze the articles published by the same five newspapers concerning the lawsuit filed by the Southeast Louisiana Flood Protection Authority-East against all ninety-seven oil and gas companies operating in the state for restitution for the wetland damage and degradation those companies had caused through their pursuit of fossil fuel resources. There was more of a values-based policy conflict between the levee board and state officials in Louisiana described in the press coverage of the issue, which lends itself more to the utility of the NPF.

CPRA's choice and application of an adaptive management framework is a further area of research on coastal restoration in Louisiana. Investigating the decision-making process that led to adaptive management being selected as the strategy for dealing with scientific uncertainty instead of other options can help understand what about this concept draws decision makers in spite of other, perhaps more suitable, strategies for handling uncertainty given the scale and

scope of the restoration work in Louisiana and the lack of clear examples demonstrating how to implement the concept. An additional issue in this vein is to explore is how stakeholders and the public understand adaptive management and what influence that has on their expectations of the master plan. Connecting the impacts of project and ecosystem monitoring to the potential for learning could bring an element of resilience to both groups' perceptions of the plan and potentially increasing trust and buy-in to the adaptive management process. Given the relative silence on the topic present in the qualitative content analysis, it is unclear how widespread conceptual knowledge of adaptive management is and what can realistically be achieved when employing the framework.

Another future research option is exploring and expanding two of the questions from the interview protocol due to the challenging nature of the responses received. The following two questions:

- Q: Would the uncertainties associated with the "happy future" scenario a layman could believe is possible after reading the 2012 Coastal Master Plan lead to a loss of faith in the plan?
- Q: Do you believe the most recent flood maps, released by FEMA in 2016, help or hinder the goals of the Coastal Master Plan to increase the sustainability and longevity of coastal Louisiana?

led to unexpected responses during the interview data collection period. As mentioned earlier in Chapter 6, 31% of the interviewees disagreed with the premise of the question, they did not believe that a layman reading either the 2012 or the 2017 version of the plan would think a " happy future" scenario would be possible even if the plan was fully funded. Given the level of scientific illiteracy of the general public, I think it is entirely possible that the public does not

understand how much land is projected to be lost and how that connects to the increased flooding risk they will experience. Some communities may be completely transformed to open water during the next 50 years, though the Coastal Master Plan is careful not to name specific communities where this may be possible. That oblique use of language, combined with general scientific illiteracy, may make it difficult for the public to understand the information the plan is imparting. Investigating this disagreement further by interviewing people directly to explore their understanding of the major areas of scientific uncertainty related to the coastal master plan and what their personal understanding is of the specific goals the plan is attempting to accomplish would shed light on how the citizens of the state are understanding this state environmental policy effort.

The flood maps question also led to some surprising results, namely that only a few of the respondents were familiar with the new maps. Both the Federal Emergency Management Agency (FEMA), through the flood maps and the National Flood Insurance Program (NFIP), and Louisiana, through the coastal master planning process led by the Coastal Restoration and Protection Authority (CPRA), are trying to reduce flood risk throughout the southern part of the state. Based on the paucity of responses to this question by the interviewees and the lack of newspaper articles covering how the programs interact, it appears that these two efforts are not in sync with each other, and given some of the liabilities and flaws of the NFIP (see Silvis 2018) it is possible they are working at cross purposes. Further study is needed to understand the policy interactions occurring in this case.

Given that the master planning process is an on-going one, with the current iteration being the 2017 plan, it would be educational to see how the codebook developed in the QCA of

the 2012 plan applied to the newspaper articles covering the implementation of the 2017 plan. The seeds for potential sources of funding and promises/warnings about the perils of political maneuvering were sown during the period of this study and it would be illuminating to see how the state continues with these seedlings, whether they flourish or perish during the next iteration of the plan. At the end of this study period, state officials finally had secured enough funding to construct a controlled sediment diversion, but had created an intense values conflict with many fishermen and oystermen as well. How Louisiana responds to this conflict will provide valuable lessons of what to do or not to do for other states that will be facing their own land loss crises in the coming decades due to climate change. Mitigation actions may not be universally popular, as demonstrated in the study, thus Louisiana is acting as a laboratory of democracy for other states to learn from its experience.

In addition to the continuing work possible in Louisiana, this study could also be expanded to include a comparison study of how science and financial uncertainty are interacting in similarly large-scale environmental science policy endeavors, such as restoration efforts in the Florida Everglades, in the Missouri River basin, or the Chesapeake Bay. For example, there is a similar history in Florida of viewing wetlands as something of little value that needed to be transformed (i.e., drained) to be useful, similar meteorological and climatological hazards affecting both Louisiana and Florida, as well as a complex political environment where decisions are shared between local, state, and federal levels of government. While Florida does not have the same history of flooding as Louisiana, nor a state-developed plan to focus restoration efforts, there is recognition within the state that the Everglades are vitally important to the ecosystem of southern Florida and that they need to be restored to some semblance of their original state.

Florida has also had more success in engaging the federal government in Everglades restoration as the USACE is actively involved in restoration projects. A key factor for such a comparison study would be the presence of local environmental science journalism discussing these regional issues. The insights provided by local journalists can help illuminate the impacts of state and local politics on restoration efforts and connect to broader trends in the how the state, or states, have allocated resources towards response.

# Appendix A

Interview Guide

1. The Coastal Master Plan defines the following categories for projects:

| | |
|---|---|
| bank stabilization | oyster barrier reefs |
| barrier island/headland restoration | ridge restoration |
| diversions | shoreline protection |
| hydrologic restoration | structural protection |
| marsh creation | nonstructural risk reduction |

   How well do you think local/parish policymakers understand the science underpinning any of these categories?
   Probes: Who does understand the science at the local level?

2. In the same vein as Question 1, how well do you think state policymakers in Baton Rouge understand the science underpinning any of these categories?
   Probes: Who does understand the science at the state level?

3. In the same vein as Questions 1 and 2, how well do you think federal policy makers in Washington DC understand the science underpinning any of these categories?
   Probes: Who does understand the science at the federal level?

4. In your own words, please define the term ‘adaptive management’.

5. How successfully has the state of Louisiana implemented an adaptive management framework, as it proposed to develop and implement in the 2012 Coastal Master Plan?
   Probes: Do you know of any project monitoring? If not, do you know someone who might know?
   Have any projects been deemed a success or failure? Why or why not? If not, do you know someone who might know?

6. Would the uncertainties associated with the “happy future” plans lead to a loss of faith in the plan?
   Probes: Political uncertainties? Financial uncertainties? Scientific uncertainties? Weather uncertainties?

7. Which areas of uncertainty (political, financial, or scientific) should be addressed first in order for the Coastal Master Plan to be successful?

8. Are there communities or areas along the coast that should be planning for coastal retreat, regardless of the success of failure of the Coastal Master Plan?

9. Do you believe the most recent flood maps, released by FEMA in 2016, help or hinder the goals of the Coastal Master Plan to increase the sustainability and longevity of coastal Louisiana?
    Probes: New maps encouraging continued development of flood-prone areas?

10. Do you think we know enough about the science of coastal processes, hydrology, and related disciplines to stabilize the coast?

Appendix B

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| | Allocation of Money: Money is in hand (or very close to it) and this is how it will be used, annual project plans fall into this category | |
| | Miscellaneous: Any article that did not fit in the other categories | |
| | Project Costs: The anticipated/forecasted costs of projects, or amount of money being requested for x or y project, money is not in hand | |
| | | Federal - Attempt: Articles discussing actual attempts at the federal level to move/use money for other than it was originally agreed to, such as through proposed bills or budget proposals |
| | | Federal - Success: Articles covering successes at the federal level in using coastal restoration money for other than it was originally agreed to, this would include a governmental entity not funding a bill passed over a decade ago |

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| Financial: The financial aspects of the master plan (such as where money may come from, what the money is going to be used for, politicians trying to use master plan money for other things, etc.) | Political Maneuvering: Speaking to either attempts or successes in using money assigned for coastal restoration/coastal master plan for something else, also included are articles with general warnings against political maneuvering | State - Warning: Articles that generally speak to how moving money from coastal restoration funds/purposes would be a bad idea, also covers state-level bills that close loop-holes that could potentially allow for money to be moved/used for non-coastal restoration |
| | | State - Attempt: Articles discussing actual attempts at the state level to move/use money for other than it was originally agreed to, such as through proposed bills, budget proposals, or attempts to get the Army Corps of Engineers to forgive the state's matching contribution for projects |
| | | State - Success: Articles covering successes at the state level in using coastal restoration money for other than it was originally agreed to, this would include using BP oil spill windfall $ for non-coastal restoration things as well as a governmental entity not funding a bill passed over a decade ago |
| | | Parish - Attempt: Articles discussing actual attempts at the parish level to move/use money for other than it was originally agreed to, such as through proposed bills or budget proposals |

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| | | Parish - Success: Articles covering successes at the parish level in using coastal restoration money for other than it was originally agreed to, this would include using BP oil spill windfall $ for non-coastal restoration things |
| | Sources of Funding: Covers how the state plans to fund the coastal master plan, also includes new or potential ideas for generating money that have not been proven at scale | Deepwater Horizon - Certain: Articles discussing confirmed funds from fines/penalties related to the Deepwater Horizon Oil Spill, this includes articles after 7/2/2015 when BP announced a settlement with the federal government as well as articles referring to the use of Transocean fines through the RESTORE Act after January of 2013 |
| | | Deepwater Horizon - Uncertain: Articles discussing possible funds from fines/ penalties related to the Deepwater Horizon Oil Spill, this includes articles covering the debates and passage of the 2012 RESTORE Act as the act had little money until Clean Water Act penalties for those companies responsible for the spill were agreed to, also articles discussing possible BP fines prior to 7/2/2015 |

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| | | Certain: Articles covering a source of funding the state has, or will soon have access to |
| | | Uncertain: Articles covering a source of funding the state does not have access to or access is in doubt, can also include new, unproven ideas that are being suggested for generating funds |
| | | Against: The purpose of the article was to argue against a particular source of funding |
| | Adaptive Management: Articles discussing adaptive management and the master plan, such as peer-reviewed papers/reports being covered by the reporter, debates about this scientific topic, etc. | |
| | Climate Change/Sea Level Rise: Articles discussing climate change and/or sea level rise and the master plan, such as peer-reviewed papers/ reports being covered by the reporter, debates about this scientific topic, etc. | 2017 Plan Revision: Majority of the article covers the need to include x or y when revising the coastal master plan for 2017 |
| | | Conflict: Majority of the article is discussing a conflict over the amount of sea level rise to expect in the coming decades |
| | | Observation: Majority of the article is discussing how climate change/sea level rise is real due to what is being observed along the coast |

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| Science: The science being used or affecting the coastal master plan (such as peer-reviewed papers/reports being covered by the reporter, debates about how this or that science finding will affect the plan, etc.) | | Research: Majority of the article is discussing a peer-reviewed paper, published report, etc. |
| | General Coastal Restoration: Articles discussing the science of coastal restoration but not specifying a topic (such as canal backfilling, limnology, traditional ecological knowledge, etc.) | |
| | Sediment Diversions: Articles | Built Diversion: Majority of the article discusses the West Bay Diversion in Plaquemines Parish |
| | | Conflict: Majority of the article discusses some facet of the conflict around sediment diversions, can include articles that are 'for' or 'against' the diversions as well as articles that discuss the conflict generally |
| | | Natural Diversion: Majority of the article discusses the Mardi Gras Pass in the Bohemia Spillway |

| 1st Dimension | 2nd Dimension | 3rd Dimension |
|---|---|---|
| | discussing sediment diversions and the master plan, such as peer-reviewed papers/reports being covered by the reporter, debates about this scientific topic, etc. | Problems/Uncertainty: Majority of the article discusses the general uncertainty around the effectiveness of the sediment diversions but does not take a side in the conflict, uncertainty as to whether or not they will actually be authorized to be built, and/or the process of authorizing planning/construction/etc. |
| | | Research - Beginning: Majority of the article discusses some research panel/project/study that is just beginning |
| | | Research: Majority of the article is discussing a peer-reviewed paper, published report, etc. |
| | Miscellaneous: Articles that covered science topics that only appeared a few times in the entire corpus | |

# References

Advocate Editorial Board. 2012. “Get Behind Louisiana Coastal Plan.” *The Advocate*, February 7, 2012.

Aklin, Michael, and Johannes Urpelainen. 2014. “Perceptions of Scientific Dissent Undermine Public Support for Environmental Policy.” *Environmental Science & Policy* 38: 173–77.

Akpo, Essegbemon, Todd A. Crane, Pierre V. Vissoh, and Rigobert C. Tossou. 2015. “Co-Production of Knowledge in Multi-Stakeholder Processes: Analyzing Joint Experimentation as Social Learning.” *The Journal of Agricultural Education and Extension* 21 (4): 369–88. https://doi.org/10.1080/1389224X.2014.939201.

Aldridge, Cameron L., Mark S. Boyce, and Richard K. Baydack. 2004. “Adaptive Management of Prairie Grouse: How Do We Get There?” *Wildlife Society Bulletin* 32 (1): 92–103. https://doi.org/10.2193/0091-7648(2004)32[92:AMOPGH]2.0.CO;2.

Alexander, Jason S., Richard C. Wilson, and W. Reed Green. 2012. “A Brief History and Summary of the Effects of River Engineering and Dams on the Mississippi River System and Delta.” USGS Numbered Series 1375. *A Brief History and Summary of the Effects of River Engineering and Dams on the Mississippi River System and Delta*. Vol. 1375. Circular. Reston, VA.: U.S. Geological Survey. https://doi.org/10.3133/cir1375.

Allen, Craig R., Joseph J. Fontaine, Kevin L. Pope, and Ahjond S. Garmestani. 2011. “Adaptive Management for a Turbulent Future.” *Journal of Environmental Management*, Adaptive management for Natural Resources, 92 (5): 1339–45. .

Allen, Craig R., and Lance H. Gunderson. 2011. “Pathology and Failure in the Design and Implementation of Adaptive Management.” *Journal of Environmental Management*, Adaptive management for Natural Resources, 92 (5): 1379–84.

Allison, Mead A., Charles R. Demas, Bruce A. Ebersole, Barbara A. Kleiss, Charles D. Little, Ehab A. Meselhe, Nancy J. Powell, Thad C. Pratt, and Brian M. Vosburg. 2012. “A Water and Sediment Budget for the Lower Mississippi-Atchafalaya River in Flood Years 2008-2010: Implications for Sediment Discharge to the Oceans and Coastal Restoration in Louisiana.” *Journal of Hydrology* 432–433: 84–97.

Allison, Mead A., and Ehab A. Meselhe. 2010. “The Use of Large Water and Sediment Diversions in the Lower Mississippi River (Louisiana) for Coastal Restoration.” *Journal of Hydrology* 387: 346–60.

Armitage, Derek, Fikret Berkes, and Nancy C. Doubleday, eds. 2007. *Adaptive Co-Management: Collaboration, Learning, and Multi-Level Governance*. Vancouver, BC: UBC Press.

Arnott, James C., Rachel J. Neuenfeldt, and Maria Carmen Lemos. 2020. "Co-Producing Science for Sustainability: Can Funding Change Knowledge Use?" *Global Environmental Change* 60 (January): 101979. https://doi.org/10.1016/j.gloenvcha.2019.101979.

Asrar, Ghassem R., James W. Hurrell, and Antonio J. Busalacchi. 2013. "A Need for 'Actionable' Climate Science and Information: Summary of WCRP Open Science Conference." *Bulletin of the American Meteorological Society* 94 (2): ES8–12.

Attride-Stirling, Jennifer. 2001. "Thematic Networks: An Analytic Tool for Qualitative Research." *Qualitative Research* 1 (3): 385–405.

Balint, Peter J., Ronald E. Stewart, Anand Desai, and Lawrence C. Walters. 2011. *Wicked Environmental Problems: Managing Uncertainty and Conflict*. Washington, D.C.: Island Press.

Barras, John A. 2006. "Land Area Change in Coastal Louisiana after the 2005 Hurricanes—a Series of Three Maps." U.S. Geological Survey Open-File Report 06-1274. https://pubs.usgs.gov/of/2006/1274/.

———. 2007. "Land Area Changes in Coastal Louisiana after Hurricanes Katrina and Rita." USGS Numbered Series 1306-5B. *Land Area Changes in Coastal Louisiana after Hurricanes Katrina and Rita*. Vol. 1306-5B. Circular. Reston, VA: U.S. Geological Survey. https://doi.org/10.3133/cir13065B.

Barry, John. 1997. *Rising Tide: The Great Mississippi Flood of 1927 and How It Changed America*. New York: Simon & Schuster.

Baustian, Joseph J., and R. Eugene Turner. 2006. "Restoration Success of Backfilling Canals in Coastal Louisiana Marshes." *Restoration Ecology* 14 (4): 636–44.

Baustian, Joseph J., R. Eugene Turner, Nancy F. Walters, and David P. Muth. 2009. "Restoration of Dredged Canals in Wetlands: A Comparison of Methods." *Wetlands Ecology and Management* 17 (5): 445–53.

Bazeley, Patricia. 2013. *Qualitative Data Analysis: Practical Strategies*. Thousand Oaks, CA: SAGE Publications Inc.

Beck, Silke. 2011. “Moving beyond the Linear Model of Expertise? IPCC and the Test of Adaptation.” *Regional Environmental Change* 11 (2): 297–306.

Bentley, Samuel, Angelina Freeman, Liviu Giosan, Clinton S. Willson, and Jaye Cable. 2012. “Usefulness of Diversions, In: Answering 10 Fundamental Questions About the Mississippi River Delta.” Baton Rouge, LA: The Mississippi River Delta Science and Engineering Special Team.

Bentley, Samuel, Clinton S. Willson, and Angelina Freeman. 2012. “Sediment Availability, In: Answering 10 Fundamental Questions About the Mississippi River Delta.” Baton Rouge, LA: The Mississippi River Delta Science and Engineering Special Team.

Berelson, Bernard. 1952. *Content Analysis in Communication Research*. New York: The Free Press.

Berman, Paul. 1980. “Thinking About Programmed and Adaptive Implementation: Matching Strategies to Situations.” In *Why Policies Succeed or Fail*, edited by Helen M. Ingram and Dean E. Mann, 205–29. Beverly Hills, CA: SAGE.

Bernstein, Marver H. 1955. *Regulating Business by Independent Commission*. Princeton, NJ: Princeton University Press.

Beven II, John L., Lixion A. Avila, Eric S. Blake, Daniel P. Brown, James L. Franklin, Richard D. Knabb, Richard J. Pasch, Jamie R. Rhome, and Stacy R. Stewart. 2008. “Annual Summary: Atlantic Hurricane Season of 2005.” *Monthly Weather Review* 136 (3): 1109–73.

Bischoping, Katherine. 1993. “Gender Differences in Conversation Topics, 1922–1990.” *Sex Roles* 28 (1): 1–18. https://doi.org/10.1007/BF00289744.

Blum, Michael D., and Harry H. Roberts. 2009. “Drowning of the Mississippi Delta Due to Insufficient Sediment Supply and Global Sea-Level Rise.” *Nature Geoscience* 2 (7): 488–91.

Bodansky, Daniel. 1991. “Law: Scientific Uncertainty and the Precautionary Principle.” *Environment: Science and Policy for Sustainable Development* 33 (7): 4–44.

Bradshaw, G. A., and Jeffrey G. Borchers. 2000a. “Uncertainty as Information: Narrowing the Science-Policy Gap.” *Ecology and Society* 4 (1): 7.

———. 2000b. “Uncertainty as Information: Narrowing the Science-Policy Gap.” *Conservation Ecology* 4 (1). http://www.jstor.org/stable/26271749.

Braun, Virginia, and Victoria Clarke. 2006. “Using Thematic Analysis in Psychology.” *Qualitative Research in Psychology* 3 (2): 77–101.

Briley, Laura, Daniel Brown, and Scott E. Kalafatis. 2015. “Overcoming Barriers during the Co-Production of Climate Information for Decision-Making.” *Climate Risk Management*, Boundary Organizations, 9 (January): 41–49. https://doi.org/10.1016/j.crm.2015.04.004.

Brinkley, Douglas. 2006. *The Great Deluge: Hurricane Katrina, New Orleans, and the Mississippi Gulf Coast*. New York City: Harper Perennial.

Bruch, Carl, and United Nations Environment Programme. 2019. *Environmental Rule of Law: First Global Report*.

Bush, Tori. 2018. “Against the Flow: The Lessons of the West Bay Sediment Diversion.” *Louisiana Cultural Vistas*, Spring 2018.

Caffey, Rex H., Hua Wang, and Daniel R. Petrolia. 2014. “Trajectory Economics: Assessing the Flow of Ecosystem Services from Coastal Restoration.” *Ecological Economics* 100 (April): 74–84. https://doi.org/10.1016/j.ecolecon.2014.01.011.

Callon, Michel, and Geof Bowker. 1994. “Is Science a Public Good? Fifth Mullins Lecture, Virginia Polytechnic Institute, 23 March 1993.” *Science, Technology, & Human Values* 19 (4): 395–424.

Cameron, James, and Juli Abouchar. 1991. “The Precautionary Principle: A Fundamental Principle of Law and Policy for the Protection of the Global Environment.” *Boston College International and Comparative Law Review* 14 (1): 1–28.

Campanella, Richard. 2008. *Bienville’s Dilemma: A Historical Geography of New Orleans*. Lafayette, LA: Center for Louisiana Studies.

Campbell, Lindsay K., Erika S. Svendsen, and Lara A. Roman. 2016. “Knowledge Co-Production at the Research-Practice Interface: Embedded Case Studies from Urban Forestry.” *Environmental Management; New York* 57 (6): 1262–80.

Castellanos, Edwin J., Catherine Tucker, Hallie Eakin, Helda Morales, Juan F. Barrera, and Rafael Díaz. 2013. "Assessing the Adaptation Strategies of Farmers Facing Multiple Stressors: Lessons from the Coffee and Global Changes Project in Mesoamerica." *Environmental Science & Policy*, Rethinking Integrated Assessments and Management Projects in the Americas, 26 (February): 19–28.

Cazenave, Anny, and William Llovel. 2010. "Contemporary Sea Level Rise." *Annual Review of Marine Science* 2: 145–73.

CERP Adaptive Management Steering Committee and Writing Team. 2006. "Comprehensive Everglades Restoration Plan Adaptive Management Strategy." Jacksonville, FL: U.S. Army Corps of Engineers. https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/2923.

Church, John A., and Neil J. White. 2006. "A 20th Century Acceleration in Global Sea-Level Rise." *Geophysical Research Letters* 33: L01602.

"Coastwide Reference Monitoring System (CRMS)." n.d. Lafayette, LA and Baton Rouge, LA: U.S. Geological Survey, Wetland and Aquatic Research Center and Coastal Protection and Restoration Authority of Louisiana. https://www.lacoast.gov/crms/crms_public_data/publications/CRMS_FactSheet_Web.pdf.

Coleman, James M. 1988. "Dynamic Changes and Processes in the Mississippi River Delta." *Geologic Society of America Bulletin* 100 (7): 999–1015.

Colten, Craig E. 2005. *An Unnatural Metropolis: Wresting New Orleans From Nature*. Baton Rouge, LA: Louisiana State University Press.

———. 2006. "Vulnerability and Place: Flat Land and Uneven Risk in New Orleans." *American Anthropologist* 108 (4): 731–34.

———. 2009. *Perilous Place, Powerful Storms: Hurricane Protection in Coastal Louisiana*. Jackson, MS: University Press of Mississippi.

———. 2018. "Cartographic Depictions of Louisiana Land Loss: A Tool for Sustainable Policies." *Sustainability* 10 (3): 763.

Conover, David O., and Stephan B. Munch. 2002. "Sustaining Fisheries Yields Over Evolutionary Time Scales." *Science* 297 (5578): 94–96.

Cooper, Christopher, and Robert Block. 2006. *Disaster: Hurricane Katrina and the Failure of Homeland Security*. New York: Holt.

Couvillion, Brady R., Holly Beck, Donald Schoolmaster, and Michelle Fischer. 2017. "Land Area Change in Coastal Louisiana (1932 to 2016)." Reston, VA: U.S. Geological Survey.

CPRA, (Coastal Protection and Restoration Authority). 2007. "Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast." Baton Rouge, LA: Coastal Protection and Restoration Authority.

———. 2012. "Louisiana's Comprehensive Master Plan for a Sustainable Coast: Committed to Our Coast." Baton Rouge, LA: Coastal Protection and Restoration Authority.

———. 2017. "Louisiana's Comprehensive Master Plan for a Sustainable Coast: Committed to Our Coast." Baton Rouge, LA: Coastal Protection and Restoration Authority.

Crosby, Molly Caldwell. 2007. *The American Plague: The Untold Story of Yellow Fever, The Epidemic That Shaped Our History*. New York City: Penguin.

Cvitanovic, C., J. McDonald, and A. J. Hobday. 2016. "From Science to Action: Principles for Undertaking Environmental Research That Enables Knowledge Exchange and Evidence-Based Decision-Making." *Journal of Environmental Management* 183 (December): 864–74. https://doi.org/10.1016/j.jenvman.2016.09.038.

Dal Bó, Ernesto. 2006. "Regulatory Capture: A Review." *Oxford Review of Economic Policy* 22 (2): 203–25. https://doi.org/10.1093/oxrep/grj013.

Daniels, Ronald J., Donald F. Kettl, and Howard Kunreuther, eds. 2006. *On Risk and Disaster: Lessons from Hurricane Katrina*. Philadelphia: University of Pennsylvania Press.

Darby, Faith A., and R. Eugene Turner. 2008a. "Below- and Aboveground Biomass of Spartina Alterniflora: Response to Nutrient Addition in a Louisiana Salt Marsh." *Estuaries and Coasts* 31 (2): 326–34. https://doi.org/10.1007/s12237-008-9037-8.

———. 2008b. "Effects of Eutrophication on Salt Marsh Root and Rhizome Biomass Accumulation." *Marine Ecology Progress Series* 363 (July): 63–70. https://doi.org/10.3354/meps07423.

Davidson, John H., and Thomas Earl Geu. 2001. "The Missouri River and Adaptive Management: Protecting Ecological Function and Legal Process." *Nebraska Law Review* 80 (4): 816–90.

Day, J. W., J. E. Cable, J. H. Cowan, R. DeLaune, K. de Mutsert, B. Fry, H. Mashriqui, et al. 2009. "The Impacts of Pulsed Reintroduction of River Water on a Mississippi Delta Coastal Basin." *Journal of Coastal Research*, no. 54 (10054) (September): 225–43.

Day, John, Conner Bailey, David Batker, Samuel Bentley, Jaye Cable, Robert Costanza, James Cowan, et al. 2012. "Answering 10 Fundamental Questions About the Mississippi River Delta." The Mississippi River Delta Science and Engineering Special Team.

Day, John W., G. Paul Kemp, Angelina M. Freeman, and David P. Muth. 2014a. "Introduction: Perspectives on the Restoration of the Mississippi Delta." In *Perspectives on the Restoration of the Mississippi Delta: The Once and Future Delta*, 1–7. Estuaries of the World. Dordrecht: Springer.

———, eds. 2014b. *Perspectives on the Restoration of the Mississippi Delta: The Once and Future Delta*. Dordrecht: Springer.

Day, John W., G. Paul Kemp, Denise J. Reed, Donald R. Cahoon, Roelof M. Boumans, Joseph M. Suhayda, and Robert Gambrell. 2011. "Vegetation Death and Rapid Loss of Surface Elevation in Two Contrasting Mississippi Delta Salt Marshes: The Role of Sedimentation, Autocompaction and Sea-Level Rise." *Ecological Engineering* 37 (2): 229–40.

Deegan, Linda A., David Samuel Johnson, R. Scott Warren, Bruce J. Peterson, John W. Fleeger, Sergio Fagherazzi, and Wilfred M. Wollheim. 2012. "Coastal Eutrophication as a Driver of Salt Marsh Loss." *Nature* 490 (7420): 388–92. https://doi.org/10.1038/nature11533.

deLeon, Peter. 1999. "The Missing Link Revisited:" *Review of Policy Research* 16 (3–4): 311–38.

deLeon, Peter, and Linda deLeon. 2002. "What Ever Happened to Policy Implementation? An Alternative Approach." *Journal of Public Administration Research and Theory* 12 (4): 467–92.

Dendy, D. Michael. 1977. "Exclusive Powers of Louisiana Home Rule Municipalities and Parishes Comment." *Loyola Law Review* 23 (4): 961–85.

Derthick, Martha. 1972. *New Towns In-Town: Why a Federal Program Failed*. Washington, D.C.: The Urban Institute.

Dilling, Lisa, and Maria Carmen Lemos. 2011. "Creating Usable Science: Opportunities and Constraints for Climate Knowledge Use and Their Implications for Science Policy." *Global Environmental Change* 21 (2): 680–89.

Djenontin, Ida Nadia S., and Alison M. Meadow. 2018. "The Art of Co-Production of Knowledge in Environmental Sciences and Management: Lessons from International Practice." *Environmental Management* 61 (6): 885–903.

Douglas, Heather E. 2009. *Science, Policy, and the Value-Free Ideal*. Pittsburgh, PA: University of Pittsburgh Press.

Dovers, Stephen R., and John W. Handmer. 1995. "Ignorance, the Precautionary Principle, and Sustainability." *Ambio* 24 (2): 92–97.

Doyle, Martin. 2018. *The Source: How Rivers Made America and America Remade Its Rivers*. New York City: W. W. Norton & Co.

Dunn, Kevin. 2010. "Interviewing." In *Qualitative Research Methods in Human Geography*, by Iain Hay, 3rd Edition, 101–38. Don Mills, Ontario: Oxford University Press.
Editorial Board. 2012. "Editorial: Mapping Louisiana's Future." *The Times-Picayune*, January 15, 2012.

Engstrom, Richard L. 1976. "Home Rule in Louisiana: Could This Be the Promised Land?" *Louisiana History: The Journal of the Louisiana Historical Association* 17 (4): 431–55.

Fabricius, Christo, and Georgina Cundill. 2014. "Learning in Adaptive Management: Insights from Published Practice." *Ecology and Society* 19 (1).

Failing, Lee, Graham Horn, and Paul Higgins. 2004. "Using Expert Judgment and Stakeholder Values to Evaluate Adaptive Management Options." *Ecology and Society* 9 (1).

Falcini, Federico, Nicole S. Khan, Leonardo Macelloni, Benjamin P. Horton, Carol B. Lutken, Karen L. McKee, Rosalia Santoleri, et al. 2012. "Linking the Historic 2011 Mississippi River Flood to Coastal Wetland Sedimentation." *Nature Geoscience* 5 (11): 803–7.

Ferman, Barbara. 1990. "When Failure Is Success: Implementation and Madisonian Government." In *Implementation and the Policy Process: Opening Up the Black Box*, edited by Dennis J. Palumbo and Donald J. Calista, 39–50. Westport, CT: Greenwood Press.

Firestein, Stuart. 2012. *Ignorance: How It Drives Science*. New York: Oxford University Press.

FitzGerald, Duncan M., Michael S. Fenster, Britt A. Argow, and Ilya V. Buynevich. 2008. "Coastal Impacts Due to Sea-Level Rise." *Annual Review of Earth and Planetary Sciences* 36: 601–47.

Foley, Rider W., Arnim Wiek, Braden Kay, and Richard Rushforth. 2017. "Ideal and Reality of Multi-Stakeholder Collaboration on Sustainability Problems: A Case Study on a Large-Scale Industrial Contamination in Phoenix, Arizona." *Sustainability Science; Dordrecht* 12 (1): 123–36. http://dx.doi.org.ezproxy.lib.ou.edu/10.1007/s11625-016-0393-1.

Fontaine, Joseph J. 2011. "Improving Our Legacy: Incorporation of Adaptive Management into State Wildlife Action Plans." *Journal of Environmental Management*, Adaptive management for Natural Resources, 92 (5): 1403–8.

Gagliano, Sherwood. 1973. "Canals, Dredging, and Land Reclamation in the Louisiana Coastal Zone." Baton Rouge, LA: Center for Wetland Resources, Louisiana State University.

Gagliano, Sherwood M., Hyuck J. Kwon, and Johannes L. van Beek. 1970. "Deterioration and Restoration of Coastal Wetlands." *Coastal Engineering*, 1767–81.

Garmestani, Ahjond S., Craig R. Allen, and Heriberto Cabezas. 2009. "Panarchy, Adaptive Management and Governance: Policy Options for Building Resilience Resilience & Environmental Law Reform Symposium." *Nebraska Law Review* 87 (4): 1036–54.

Gerlak, Andrea K. 2008. "Today's Pragmatic Water Policy: Restoration, Collaboration, and Adaptive Management Along U.S. Rivers." *Society & Natural Resources* 21 (6): 538–45.

Glick, Patty, Jonathan Clough, Amy Polaczyk, Brady R. Couvillion, and Brad Nunley. 2013. "Potential Effects of Sea-Level Rise on Coastal Wetlands in Southeastern Louisiana." *Journal of Coastal Research* 63 (sp1): 211–33.

Goggin, Malcolm L., Ann O'M. Bowman, James P. Lester, and Laurence J. O'Toole. 1990. *Implementation Theory and Practice: Towards a Third Generation*. Glenview, IL: Scott, Foresman/Little, Brown.

González, Juan L., and Torbjörn E. Törnqvist. 2006. "Coastal Louisiana in Crisis: Subsidence or Sea Level Rise?" *EOS, Transactions American Geophysical Union* 87 (45): 493–508.

Gotham, Kevin Fox. 2016. "Coastal Restoration as Contested Terrain: Climate Change and the Political Economy of Risk Reduction in Louisiana." *Sociological Forum* 31 (S1): 787–806.

Gray, J. S., and J. M. Bewers. 1996. "Towards a Scientific Definition of the Precautionary Principle." *Marine Pollution Bulletin* 32 (11): 768–71.

Greenberg, David H., and Marvin B. Mandell. 1991. "Research Utilization in Policymaking: A Tale of Two Series (of Social Experiments)." *Journal of Policy Analysis and Management* 10 (4): 633–56. https://doi.org/10.2307/3324989.

Gregory, R., D. Ohlson, and J. Arvai. 2006. "Deconstructing Adaptive Management: Criteria for Applications to Environmental Management." *Ecological Applications* 16 (6): 2411–25.

Grunwald, Michael. 2006. *The Swamp: The Everglades, Florida, and the Politics of Paradise*. New York: Simon & Schuster.

Guillory, Kodi. 2017. "Mississippi River Sediment Diversion Program." Presented at the Oyster Task Force Meeting, New Orleans, LA, May 30.

Guinto, D., and R. Reed. 2008. "Adaptive Management and the Comprehensive Everglades Restoration Plan." In *Real-Time and Deliberative Decision Making*, edited by Igor Linkov, Elizabeth Ferguson, and Victor S. Magar, 213–21. NATO Science for Peace and Security Series C: Environmental Security. Dordrecht: Springer Netherlands.

Gullett, Warwick. 1997. "Environmental Protection and the Precautionary Principle: A Response to Scientific Uncertainty in Environmental Management." *Environmental and Planning Law Journal* 14 (1): 52–69.

Gunderson, Lance. 1999. "Resilience, Flexibility and Adaptive Management – – Antidotes for Spurious Certitude?" *Conservation Ecology* 3 (1). http://www.jstor.org/stable/26271703.

Gunderson, Lance H. 2001. "SOUTH FLORIDA: THE REALITY OF CHANGE AND THE PROSPECTS FOR SUSTAINABILITY: Managing Surprising Ecosystems in Southern Florida." *Ecological Economics* 37 (3): 371–78.

Gunderson, Lance, and Stephen S. Light. 2006. “Adaptive Management and Adaptive Governance in the Everglades Ecosystem.” *Policy Sciences* 39 (4): 323–34.

Guston, David H. 1999. “Stabilizing the Boundary between US Politics and Science:: The Rôle of the Office of Technology Transfer as a Boundary Organization.” *Social Studies of Science* 29 (1): 87–111. https://doi.org/10.1177/030631299029001004.

———. 2001. “Boundary Organizations in Environmental Policy and Science: An Introduction.” *Science, Technology, & Human Values* 26 (4): 399–408.

Hallowell, Christopher. 2005. *Holding Back the Sea: The Struggle on the Gulf Coast to Save America*. New York: Harper Perennial.

Hayden, Thomas, and Erica Check Hayden. 2018. “Science Journalism’s Unlikely Golden Age.” *Frontiers in Communication* 2: 24.

Heerden, Ivor Ll. van. 2007. “The Failure of the New Orleans Levee System Following Hurricane Katrina and the Pathway Forward.” *Public Administration Review*, no. Special Issue (December): 24–35.

Heerden, Ivor Ll. van, and Mike Bryan. 2006. *The Storm: What Went Wrong and Why During Hurricane Katrina - the Inside Story from One Louisiana Scientist*. New York: Penguin.

Heil, Simone. 2011. *Young Ambassadors: Youth Exchange and the Special Relationship between Germany and the State of Israel*. Baden-Baden: Nomos Verlagsgesellschaft.

Hilborn, Ray. 1992. “Can Fisheries Agencies Learn from Experience?” *Fisheries* 17 (4): 6–14.

Hjern, Benny. 1982. “Implementation Research: The Link Gone Missing.” *Journal of Public Policy* 2 (3): 301–8.

Hjern, Benny, and Chris Hull. 1983. “Implementation Research as Empirical Constitutionalism.” *European Journal of Political Research* 10 (2): 105–15.

Hollander, Gail M. 2008. *Raising Cane in the ’Glades: The Global Sugar Trade and the Transformation of Florida*. Chicago: The University of Chicago Press.

Holling, C. S., ed. 1978. *Adaptive Environmental Assessment and Management*. Chichester, UK: Wiley.

Horne, Jed. 2006. *Breach of Faith: Hurricane Katrina and the Near Death of a Great American City*. New York City: Random House.

Houck, Oliver A. 1983. "Land Loss in Coastal Louisiana: Causes, Consequences, and Remedies Symposium on Land Loss in the Louisiana Coastal Zone." *Tulane Law Review* 58 (1): 3–168.

———. 2015. "The Reckoning: Oil and Gas Development in the Louisiana Coastal Zone." *Tulane Environmental Law Journal* 28 (2): 185–296.

Howes, Michael, Liana Wortley, Ruth Potts, Aysin Dedekorkut-Howes, Silvia Serrao-Neumann, Julie Davidson, Timothy Smith, and Patrick Nunn. 2017. "Environmental Sustainability: A Case of Policy Implementation Failure?" *Sustainability* 9 (2): 165.

Howes, Nick C., Duncan M. FitzGerald, Zoe J. Hughes, Ioannis Y. Georgiou, Mark A. Kulp, Michael D. Miner, Jane M. Smith, and John A. Barras. 2010. "Hurricane-Induced Failure of Low Salinity Wetlands." *Proceedings of the National Academy of Sciences* 107 (32): 14014–19. https://doi.org/10.1073/pnas.0914582107.

Hsieh, Hsiu-Fang, and Sarah E. Shannon. 2005. "Three Approaches to Qualitative Content Analysis." *Qualitative Health Research* 15 (9): 1277–88.

"In-Depth News and Investigations for New Orleans." The Lens, Last Modified May 5, 2020. Date Accessed June 25, 2020. https://thelensnola.org/.

Ingram, Helen M. 1990. "Implementation: A Review and Suggested Framework." In *Public Administration: The State of the Discipline*, edited by Naomi B. Lynn and Aaron Wildavsky, 462–80. Chatham, NJ: Chatham House.

Innes, Judith E., and David E. Booher. 2010. *Planning with Complexity: An Introduction to Collaborative Rationality for Public Policy*. 1st ed. London: Routledge.

Irwin, Larry L., and T. Bently Wigley. 1993. "Toward an Experimental Basis for Protecting Forest Wildlife." *Ecological Applications* 3 (2): 213–17. https://doi.org/10.2307/1941823.

Jamieson, Dale. 1992. "Ethics, Public Policy, and Global Warming." *Science, Technology, & Human Values* 17 (2): 139–53.

Jasanoff, Sheila. 1996. "Beyond Epistemology: Relativism and Engagement in the Politics of Science." *Social Studies of Science* 26 (2): 393–418.

Johnson, David L. 2006. “Hurricane Katrina: August 23-31, 2005.” Service Assessment. US Department of Commerce, National Oceanic and Atmospheric Administration, and National Weather Service.

Johnson, Fred A., Byron K. Williams, James D. Nichols, James E. Hines, William L. Kendall, Graham W. Smith, and David F. Caithamer. 1993. “Developing an Adaptive Management Strategy for Harvesting Waterfowl in North America.” *Transactions of the North American Wildlife and Natural Resources Conference* 58: 565–83.

Johnson, Fred, and Ken Williams. 1999. “Protocol and Practice in the Adaptive Management of Waterfowl Harvests.” *Conservation Ecology* 3 (1). http://www.jstor.org/stable/26271704.

Jones, Michael D., Mark K. McBeth, and Elizabeth A. Shanahan. 2014. “Introducing the Narrative Policy Framework.” In *The Science of Stories: Applications of the Narrative Policy Framework in Public Policy Analysis*, edited by Michael D. Jones, Elizabeth A. Shanahan, and Mark K. McBeth, 1–25. New York City: Palgrave Macmillan.

Jones, Michael D., Elizabeth A. Shanahan, and Mark K. McBeth, eds. 2014. *The Science of Stories: Applications of the Narrative Policy Framework in Public Policy Analysis*. New York: Palgrave Macmillan.

Jordan, Andrew, and Timothy O’Riordan. 1999. “The Precautionary Principle in Contemporary Environmental Policy and Politics.” In *Protecting Public Health and the Environment: Implementing The Precautionary Principle*, edited by Carolyn Raffensperger and Joel Tickner, 15–35. Washington, D.C.: Island Press.

Kapustka, Katherine M., Penny Howell, Christine D. Clayton, and Shelley Thomas. 2009. “Social Justice in Teacher Education: A Qualitative Content Analysis of NCATE Conceptual Frameworks.” *Equity & Excellence in Education* 42 (4): 489–505.

Kearney, Michael S., J. C. Alexis Riter, and R. Eugene Turner. 2011. “Freshwater River Diversions for Marsh Restoration in Louisiana: Twenty-Six Years of Changing Vegetative Cover and Marsh Area.” *Geophysical Research Letters* 38 (16). https://doi.org/10.1029/2011GL047847.

Keeney, Ralph L., and Detlof Von Winterfeldt. 2001. “Appraising the Precautionary Principle – a Decision Analysis Perspective.” *Journal of Risk Research* 4 (2): 191–202.

Keim, Barry D., and Robert A. Muller. 2009. *Hurricanes of the Gulf of Mexico*. Baton Rouge, LA: Louisiana State University Press.

Keim, Barry D., Robert A. Muller, and Gregory W. Stone. 2007. "Spatiotemporal Patterns and Return Periods of Tropical Storm and Hurricane Strikes from Texas to Maine." *Journal of Climate* 20 (July): 3498–3509.

Kelman, Ari. 2006. *A River and Its City: The Nature of Landscape in New Orleans*. Berkeley, CA: University of California Press.

Kesel, R.H. 2003. "Human Modifications to the Sediment Regime of the Lower Mississippi River Flood Plain." *Geomorphology* 56 (3–4): 325–34.

Kingdon, John W. 2010. *Agendas, Alternatives and Public Policies*. Updated 2nd. New York: Harper Collins.

Kirchhoff, Christine J., Maria Carmen Lemos, and Suraje Dessai. 2013. "Actionable Knowledge for Environmental Decision Making: Broadening the Usability of Climate Science." *Annual Review of Environment and Resources* 38 (1): 393–414. .

Kirono, Dewi G., C, Silva Larson, Grace Tjandraatmadja, Anne Leitch, Luis Neumann, Shiroma Maheepala, Roland Barkey, Amran Achmad, and Mary Selintung. 2014. "Adapting to Climate Change through Urban Water Management: A Participatory Case Study in Indonesia." *Regional Environmental Change; Dordrecht* 14 (1): 355–67. .

Klein, Christine A., and Sandra B. Zellmer. 2014. *Mississippi River Tragedies: A Century of Unnatural Disaster*. New York: New York University Press.

Klenk, Nicole L., Katie Meehan, Sandra Lee Pinel, Fabian Mendez, Pablo Torres Lima, and Daniel M. Kammen. 2015. "Stakeholders in Climate Science: Beyond Lip Service?" *Science* 350 (6262): 743–44. https://doi.org/10.1126/science.aab1495.

Knabb, Richard D., Daniel P. Brown, and Jamie R. Rhome. 2011. "Tropical Cyclone Report: Hurricane Rita 18-26 September 2005." National Hurricane Center.

Knabb, Richard D., Jamie R. Rhome, and Daniel P. Brown. 2011. "Tropical Cyclone Report: Hurricane Katrina, 23-30 August 2005." National Hurricane Center.

Knox, Claire Connolly. 2017. "A Football Field Lost Every 45 Minutes: Evaluating Local Capacity to Implement Louisiana's Coastal Master Plan." *Coastal Management* 43 (5): 233–52.

Kraaijvanger, Richard, Tom Veldkamp, and Conny Almekinders. 2016. "Considering Change: Evaluating Four Years of Participatory Experimentation with Farmers in Tigray (Ethiopia) Highlighting Both Functional and Human–Social Aspects." *Agricultural Systems* 147 (September): 38–50. https://doi.org/10.1016/j.agsy.2016.05.001.

Kracauer, Siegfried. 1952. "The Challenge of Qualitative Content Analysis." *The Public Opinion Quarterly* 16 (4): 631–42.

Kuckartz, Udo. 2019. "Qualitative Content Analysis: From Kracauer's Beginnings to Today's Challenges." *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 20 (3). https://doi.org/10.17169/fqs-20.3.3370.

Lane, Robert R., John W. Day, and Jason N. Day. 2006. "Wetland Surface Elevation, Vertical Accretion, and Subsidence at Three Louisiana Estuaries Receiving Diverted Mississippi River Water." *Wetlands* 26 (4): 1130–42.

Le Quesne, Tom, Eloise Kendy, and Derek Weston. 2010. "The Implementation Challenge: Taking Stock of Government Policies to Protect and Restore Environmental Flows." The Nature Conservancy and WWF. https://www.conservationgateway.org/ConservationPractices/Freshwater/EnvironmentalFlows/MethodsandTools/ELOHA/Documents/Global%20flows%20report%20final%20LowRes.pdf.

Lee, Kai N. 1993. *Compass and Gyroscope: Integrating Science and Politics for the Environment*. Washington D.C.: Island Press.

———. 1999. "Appraising Adaptive Management." *Conservation Ecology* 3 (2). http://www.jstor.org/stable/26271726.

Lemos, Maria Carmen, James C. Arnott, Nicole M. Ardoin, Kristin Baja, Angela T. Bednarek, Art Dewulf, Clare Fieseler, et al. 2018. "To Co-Produce or Not to Co-Produce." *Nature Sustainability* 1 (12): 722–24. https://doi.org/10.1038/s41893-018-0191-0.

Lemos, Maria Carmen, Christine J. Kirchhoff, Scott E. Kalafatis, Donald Scavia, and Richard B. Rood. 2014. "Moving Climate Information off the Shelf: Boundary Chains and the Role of RISAs as Adaptive Organizations." *Weather, Climate, and Society* 6 (2): 273–85. .

Lemos, Maria Carmen, Christine J. Kirchhoff, and Vijay Ramprasad. 2012. "Narrowing the Climate Information Usability Gap." *Nature Climate Change* 2 (11): 789–94.

Lemos, Maria Carmen, and Barbara J. Morehouse. 2005. "The Co-Production of Science and Policy in Integrated Climate Assessments." *Global Environmental Change* 15 (1): 57–68.

Lester, James P., and Malcolm L. Goggin. 1998. "Back to the Future: The Rediscovery of Implementation Studies." *Policy Currents* 8 (3): 1–9.

Light, Alfred R. 2006. "Tales of the Tamiami Trail: Implementing Adaptive Management in Everglades Restoration." *Journal of Land Use & Environmental Law* 22 (1): 59–99.

Lipsky, Michael. 1980. *Street-Level Bureaucracy: Dilemma of the Individual in Public Services*. New York: Russell Sage Foundation.

López, Andrea, Alissa Detz, Neda Ratanawongsa, and Urmimala Sarkar. 2012. "What Patients Say About Their Doctors Online: A Qualitative Content Analysis." *Journal of General Internal Medicine* 27 (6): 685–92. https://doi.org/10.1007/s11606-011-1958-4.

LoSchiavo, Andrew J., Ronnie G. Best, Rebecca E. Burns, Susan Gray, Matthew C. Harwell, Eliza B. Hines, Agnes R. McLean, Tom St. Clair, Steve Traxler, and James W. Vearil. 2013. "Lessons Learned from the First Decade of Adaptive Management in Comprehensive Everglades Restoration." *Ecology and Society* 18 (4). .

Makkai, Toni, and John Braithwaite. 1992. "In and Out of the Revolving Door: Making Sense of Regulatory Capture*." *Journal of Public Policy* 12 (1): 61–78.

Manson, Neil A. 2002. "Formulating the Precautionary Principle." *Environmental Ethics* 24 (3): 263–74.

Marshall, Bob. 2013a. "Top State Official Rebuts Dire Warning, Insists Coast Can Be Saved." *The Lens*, February 27, 2013.

———. 2013b. "New Research Indicates Mississippi River Diversions Could Harm Marshland." *The Lens*, April 10, 2013.

Marvasti, Amir. 2019. "Qualitative Content Analysis: A Novice's Perspective." *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 20 (3). https://doi.org/10.17169/fqs-20.3.3387.

Matland, Richard E. 1995. "Synthesizing the Implementation Literature: The Ambiguity-Conflict Model of Policy Implementation." *Journal of Public Administration Research and Theory* 5 (2): 145–74.

May, Peter J. 2015. “Implementation Failures Revisited: Policy Regime Perspectives.” *Public Policy and Administration* 30 (3–4): 277–99. https://doi.org/10.1177/0952076714561505.

Mayring, Philipp. 2000. “Qualitative Content Analysis.” *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 1 (2). https://doi.org/10.17169/fqs-1.2.1089.

———. 2010. *Qualitative Inhaltsanalyse. Grundlagen Und Techniken*. 11th revised. Weinheim: Beltz.

———. 2019. “Qualitative Content Analysis: Demarcation, Varieties, Developments.” *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 20 (3). https://doi.org/10.17169/fqs-20.3.3343.

Mazmanian, Daniel, and Paul A. Sabatier. 1983. *Implementation and Public Policy*. Glendale, IL: Scott, Foresman.

McCarthy, James J. 2009. “Reflections On: Our Planet and Its Life, Origins, and Futures.” *Science* 326 (5960): 1646–55.

McCright, Aaron M., and Riley E. Dunlap. 2011. “The Politicization of Climate Change and Polarization in the American Public’s Views of Global Warming, 2001-2010.” *The Sociological Quarterly* 52 (2): 155–94.

McDonald, Matthew G., Stephen Wearing, and Jess Ponting. 2009. “The Nature of Peak Experience in Wilderness.” *The Humanistic Psychologist* 37 (4): 370–85. .

McFadden, Jamie E., Tim L. Hiller, and Andrew J. Tyre. 2011. “Evaluating the Efficacy of Adaptive Management Approaches: Is There a Formula for Success?” *Journal of Environmental Management*, Adaptive management for Natural Resources, 92 (5): 1354–59. https://doi.org/10.1016/j.jenvman.2010.10.038.

McGowan, Conor P., David R. Smith, James D. Nichols, Julien Martin, John A. Sweka, James E. Lyons, Lawrence J. Niles, et al. 2009. “A Framework for the Adaptive Management of Horseshoe Crab Harvest in the Delaware Bay Constrained by Red Knot Conservation.” Stock Assessment Report No. 09-02 (Supplement B). Atlantic State Marine Fisheries Commission. https://www.asmfc.org/uploads/file/2009DelawareBayARMReport.pdf.

McQuaid, John, and Mark Schleifstein. 2006. *Path of Destruction: The Devastation of New Orleans and the Coming Age of Superstorms*. New York City: Little, Brown and Company.

Meadow, Alison M., Daniel B. Ferguson, Zack Guido, Alexandra Horangic, Gigi Owen, and Tamara Wall. 2015. "Moving toward the Deliberate Coproduction of Climate Science Knowledge." *Weather, Climate, and Society* 7 (2): 179–91.

Meyers, Steve. 2012. "Times-Picayune to Publish Three Days a Week, Cut Staff." *Poynter*, May 24, 2012. https://www.poynter.org/reporting-editing/2012/times-picayune-confirms-end-of-daily-publication/.

Miller, Gregory. 2004. "Mississippi River - West Bay Sediment Diversion." *Critical Transitions in Water and Environmental Resources Management*, 1–7. https://doi.org/10.1061/40737(2004)402.

Milon, J. Walter, Clyde F. Kiker, and Donna J. Lee. 1997. "Ecosystem Management and the Florida Everglades: The Role of Social Scientists." *Journal of Agricultural and Applied Economics* 29 (1): 99–107. https://doi.org/10.1017/S1074070800007586.

MINDEC (1987). Ministerial Declaration of the Second International Conference on the Protection of the North Sea. 24–25 November 1987, London, UK.

———. (1990). Ministerial Declaration of the Third International Conference on the Protection of the North Sea. 7–8 March 1990, The Hague, Netherlands.

Moerschbaecher, Matthew Korbel. 2008. "The Impact of the Caernarvon Diversion on Above- and Belowground Marsh Biomass in the Breton Sound Estuary after Hurricane Katrina." M.S. Thesis, Baton Rouge, LA: Louisiana State University.

Moir, W. H., and W. M. Block. 2001. "Adaptive Management on Public Lands in the United States: Commitment or Rhetoric?" *Environmental Management* 28 (2): 141–48. .

Morgan, David L. 1993. "Qualitative Content Analysis: A Guide to Paths Not Taken." *Qualitative Health Research* 3 (1): 112–21. .

Morris, Christopher. 2012. *The Big Muddy: An Environmental History of the Mississippi and Its Peoples from Hernando de Soto to Hurricane Katrina*. New York: Oxford University Press.

Morris, J. T., G. P. Shaffer, and J. A. Nyman. 2013. "Brinson Review: Perspectives on the Influence of Nutrients on the Sustainability of Coastal Wetlands." *Wetlands* 33 (6): 975–88. https://doi.org/10.1007/s13157-013-0480-3.

Moss, R. H., G. A. Meehl, M. C. Lemos, J. B. Smith, J. R. Arnold, J. C. Arnott, D. Behar, et al. 2013. "Hell and High Water: Practice-Relevant Adaptation Science." *Science* 342 (6159): 696–98. https://doi.org/10.1126/science.1239569.

Murphy, Tim. 2014. "This Republican Admits Rising Seas Are Swallowing His District. But Can He Say That in Washington?" *Mother Jones*, November 17, 2014. https://www.motherjones.com/politics/2014/11/garret-graves-louisiana-pragmatic-climate-denier/.

Nakamura, Robert T., and Frank Smallwood. 1980. *The Politics of Policy Implementation*. New York: St. Martin's.

National Ecological Assessment Team. 2006. "Strategic Habitat Conservation: Final Report." Reston, VA and Washington, DC.: U.S. Geological Survey and US Fish and Wildlife Service.

National Research Council. 2009. *Informing Decisions in a Changing Climate*. https://doi.org/10.17226/12626.

———. 2012. *Using Science as Evidence in Public Policy*. Washington D.C.: National Academies Press. https://doi.org/10.17226/13460.

Neal, Homer A., Tobin L. Smith, and Jennifer B. McCormick. 2008. *Beyond Sputnik: U.S. Science Policy in the 21st Century*. Ann Arbor: University of Michigan Press.

Neill, Christopher, and R. Eugene Turner. 1987. "Backfilling Canals to Mitigate Wetland Dredging in Louisiana Coastal Marshes." *Environmental Management* 11 (6): 823–36.

Newton, Alice, and Michael Elliott. 2016. "A Typology of Stakeholders and Guidelines for Engagement in Transdisciplinary, Participatory Processes." *Frontiers in Marine Science* 3. https://doi.org/10.3389/fmars.2016.00230.

Nichols, James D., Michael C. Runge, Fred A. Johnson, and Byron K. Williams. 2007. "Adaptive Harvest Management of North American Waterfowl Populations: A Brief History and Future Prospects." *Journal of Ornithology* 148 (2): 343–49. .

Nittrouer, Jeffrey A., and Enrica Viparelli. 2014. "Sand as a Stable and Sustainable Resource for Nourishing the Mississippi River Delta." *Nature Geoscience* 7 (5): 350–54. .

Nyman, J. A. 2014. "Integrating Successional Ecology and the Delta Lobe Cycle in Wetland Research and Restoration." *Estuaries and Coasts* 37 (6): 1490–1505. .

Oakley, Ann. 2018. *From Here to Maternity: Becoming a Mother*. Bristol: Bristol University Press.

"Office of Conservation: Permit to Drill Applications." Department of Natural Resources | State of Louisiana. Accessed February 7, 2020. http://www.dnr.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=166.

Olshansky, Robert B., and Laurie A. Johnson. 2010. *Clear As Mud: Planning for the Rebuilding of New Orleans*. Chicago, IL: American Planning Association Planners Press.

O'Neill, Karen M. 2006. *Rivers by Design: State Power and the Origins of U.S. Flood Control*. Durham: Duke University Press.

Oppenheimer, Michael, Naomi Oreskes, Dale Jamieson, Keynyn Brysse, Jessica O'Reilly, Matthew Shindell, and Milena Wazeck. 2019. *Discerning Experts: The Practice of Scientific Assessment for Environmental Policy*. Chicago, IL: University of Chicago Press.

Oreskes, Naomi. 2004. "The Scientific Consensus on Climate Change." *Science* 306 (December): 1686.

Oreskes, Naomi, and Erik M. Conway. 2010. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. New York: Bloomsbury Press.

O'Riordan, Timothy, and Andrew Jordan. 1995. "The Precautionary Principle in Contemporary Environmental Politics." *Environmental Values* 4 (3): 191–212. .

OSPAR. (1992). Final Declaration of the Ministerial Meetings of the Oslo and Paris Commissions. Oslo and Paris Conventions for the Prevention of Marine Pollution, Paris, 21–22 September 1992.

———. (1998). The Sintra Statement, Final Declaration of the Ministerial Meeting of the Oslo and Paris Commissions. Oslo and Paris Conventions for the Prevention of Marine Pollution, Sintra, 20–24 July 1998.

O'Toole, Laurence J. 2000. "Research on Policy Implementation: Assessment and Prospects." *Journal of Public Administration Research and Theory* 10 (2): 263–88. .

Palinkas, Lawrence A., Sarah M. Horwitz, Carla A. Green, Jennifer P. Wisdom, Naihua Duan, and Kimberly Hoagwood. 2015. "Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research." *Administration and Policy in Mental Health and Mental Health Services Research* 42 (5): 533–44. .

Parent, Wayne. 2004. *Inside the Carnival: Unmasking Louisiana Politics*. Baton Rouge, LA: Louisiana State University Press.

Parma, Ana M., and NCEAS Working Group on Population Management. 1998. "What Can Adaptive Management Do for Our Fish, Forests, Food, and Biodiversity?" *Integrative Biology: Issues, News, and Reviews* 1 (1): 16–26. https://doi.org/10.1002/(SICI)1520-6602(1998)1:1<16::AID-INBI3>3.0.CO;2-D.

Patton, Michael Quinn. 2002. *Qualitative Research & Evaluation Methods*. 3rd ed. Thousand Oaks, CA: SAGE Publications Inc.

Peterson, Garry D., Graeme S. Cumming, and Stephen R. Carpenter. 2003. "Scenario Planning: A Tool for Conservation in an Uncertain World." *Conservation Biology* 17 (2): 358–66. .

Petrolia, Daniel R., Matthew G. Interis, and Joonghyun Hwang. 2014. "America's Wetland? A National Survey of Willingness to Pay for Restoration of Louisiana's Coastal Wetlands." *Marine Resource Economics* 29 (1): 17–37. https://doi.org/10.1086/676289.

Peyronnin, Natalie, Rex Caffey, James H. Cowan Jr., Justic Dubravko, Alex Kolker, Alex McCorquodale, Earl Melancon Jr., et al. 2016. "Building Land in Coastal Louisiana: Expert Recommendations for Operating a Successful Sediment Diversion That Balances Ecosystem and Community Needs." RESTORE The Mississippi River Delta. www.MississippiRiverDelta.org/ DiversionOpsReport.

Peyronnin, Natalie, Mandy Green, Carol Parsons Richards, Alaina Owens, Denise Reed, Joanne Chamberlain, David G. Groves, William K. Rhinehart, and Karim Belhadjali. 2013. "Louisiana's 2012 Coastal Master Plan: Overview of a Science-Based and Publicly Informed Decision-Making Process." *Journal of Coastal Research* 67 (Sp 1): 1–15.

Pielke, Roger. 2002. "Better Safe than Sorry." *Nature* 419 (6906): 433–34. https://doi.org/10.1038/419433a.

Pielke, Roger A. 2007. *The Honest Broker: Making Sense of the Science in Policy and Politics*. Cambridge: Cambridge University Press.

Pielke, Roger A., and Radford Byerly. 1998. “Beyond Basic and Applied.” *Physics Today* 51 (2): 42–46.

Pinkerton, Evelyn. 1999. “Factors in Overcoming Barriers to Implementing Co–Management in British Columbia Salmon Fisheries.” *Conservation Ecology* 3 (2). .

Podestá, Guillermo P., Claudia E. Natenzon, Cecilia Hidalgo, and Fernando Ruiz Toranzo. 2013. “Interdisciplinary Production of Knowledge with Participation of Stakeholders: A Case Study of a Collaborative Project on Climate Variability, Human Decisions and Agricultural Ecosystems in the Argentine Pampas.” *Environmental Science & Policy*, Rethinking Integrated Assessments and Management Projects in the Americas, 26 (February): 40–48. https://doi.org/10.1016/j.envsci.2012.07.008.

Prasad, Bammidi Devi. 2019. “Qualitative Content Analysis: Why Is It Still a Path Less Taken?” *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 20 (3). https://doi.org/10.17169/fqs-20.3.3392.

Pregernig, Michael. 2006. “Transdisciplinarity Viewed from Afar: Science-Policy Assessments as Forums for the Creation of Transdisciplinary Knowledge.” *Science and Public Policy* 33 (6): 445–55. https://doi.org/10.3152/147154306781778867.

Pressman, Jeffrey L., and Aaron Wildavsky. 1973. *Implementation: How Great Expectations in Washington Are Dashed in Oakland; Or, Why It’s Amazing That Federal Programs Work at All, This Being a Saga of the Economic Development Administration as Told by Two Sympathetic Observers Who Seek to Build Morals on a Foundation of Ruined Hopes*. 1st ed. Oakland Project. Berkeley, CA: University of California Press.

———. 1984. *Implementation: How Great Expectations in Washington Are Dashed in Oakland; Or, Why It’s Amazing That Federal Programs Work at All, This Being a Saga of the Economic Development Administration as Told by Two Sympathetic Observers Who Seek to Build Morals on a Foundation of Ruined Hopes*. 3rd ed. Oakland Project. Berkeley, CA: University of California Press.

Quigley, Thomas Milton, and Sylvia J. Arbelbide, eds. 1997. *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins: Volume 1*. Pacific Northwest Research Station, Portland, OR: US Department of Agriculture, Forest Service.

Raffensperger, Carolyn, and Joel Tickner, eds. 1999. *Protecting Public Health and the Environment: Implementing The Precautionary Principle*. Washington, D.C.: Island Press.

Rapp, Valerie. 2008. "Northwest Forest Plan—the First 10 Years (1994–2003): First-Decade Results of the Northwest Forest Plan." General Technical Report PNW-GTR-720. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. https://www.fs.usda.gov/treesearch/pubs/29319.

Reed, Denise, and Natalie Peyronnin, eds. 2013. "Special Issue 67 - Louisiana's 2012 Coastal Master Plan Technical Analysis." *Journal of Coastal Research* 67 (sp 1): 1–161.

Reeves, Gordon H., Jack E. Williams, Kelly M. Burnett, and Kirsten Gallo. 2006. "The Aquatic Conservation Strategy of the Northwest Forest Plan." *Conservation Biology* 20 (2): 319–29. https://doi.org/10.1111/j.1523-1739.2006.00380.x.

Reuss, Martin. 1998. *Designing the Bayous: The Control of Water in the Atchafalaya Basin 1800-1995*. Alexandria, VA: US Army Corps of Engineers.

RioDEC (1992). Rio Declaration on Environment and Development, ISBN 9-21-100509-4, 1992.

Rivlin, Gary. 2015. *Katrina: After the Flood*. New York: Simon & Schuster.

Robertson, Campbell. 2013. "Facing Fire Over Challenge to Louisiana's Oil Industry." *The New York Times*, August 31, 2013. https://www.nytimes.com/2013/09/01/us/facing-fire-over-challenge-to-louisianas-oil-industry.html.

Roller, Margaret R. 2019. "A Quality Approach to Qualitative Content Analysis: Similarities and Differences Compared to Other Qualitative Methods." *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 20 (3). https://doi.org/10.17169/fqs-20.3.3385.

Ruhl, J. B. 2008. "Adaptive Management for Natural Resources - Inevitable, Impossible, or Both?" *Rocky Mountain Law Institute* 54 (11). https://papers.ssrn.com/abstract=1337749.

Ruhl, J. B., and Robert L. Fischman. 2010. "Adaptive Management in the Courts." *Minnesota Law Review* 95 (2): 424–84.

Russell, Pam Radtke. 2018. "Mississippi River Diversions Could Save Louisiana's Drowning Coast." *Engineering News-Record*, August 9, 2018. https://www.enr.com/articles/44968-mississippi-river-diversions-could-save-louisianas-drowning-coast#comments.

Saetren, Harald. 2005. "Facts and Myths about Research on Public Policy Implementation: Out-of-Fashion, Allegedly Dead, But Still Very Much Alive and Relevant." *Policy Studies Journal* 33 (4): 559–82. https://doi.org/10.1111/j.1541-0072.2005.00133.x.

Santillo, D., R. L. Stringer, P. A. Johnston, and J. Tickner. 1998. "The Precautionary Principle: Protecting against Failures of Scientific Method and Risk Assessment." *Marine Pollution Bulletin* 36 (12): 939–50. https://doi.org/10.1016/S0025-326X(98)80003-9.

Sarewitz, Daniel. 2004. "How Science Makes Environmental Controversies Worse." *Environmental Science & Policy* 7 (5): 385–403.

Scheberle, Denise. 1997. *Federalism and Environmental Policy*. Washington, D.C.: Georgetown University Press.

Schleifstein, Mark. 2013. "Jindal Opposes Coastal Erosion Lawsuit Due to Oil Industry Contributions, Environmental Groups Say." *The Times-Picayune*, August 28, 2013.

Schreier, Margrit. 2012. *Qualitative Content Analysis in Practice*. Thousand Oaks, CA: SAGE Publications Inc.

Schreier, Margrit, Christoph Stamann, Markus Janssen, Thomas Dahl, and Amanda Whittal. 2019. "Qualitative Content Analysis: Conceptualizations and Challenges in Research Practice—Introduction to the FQS Special Issue 'Qualitative Content Analysis I.'" *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 20 (3). https://doi.org/10.17169/fqs-20.3.3393.

Seidman, Irving. 2019. *Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences*. 5th Edition. New York City: Teachers College Press.

Shallat, Todd. 1994. *Structures in the Stream: Water, Science, and the Rise of the U.S. Army Corps of Engineers*. Austin, TX: University of Texas Press.

———. 2014. *Hope for the Dammed: The U.S. Army Corps of Engineers and the Greening of the Mississippi*. Kansas City, MO: American Public Works Association.

Shanahan, Elizabeth A., Michael D. Jones, Mark K. McBeth, and Ross R. Lane. 2013. "An Angel on the Wind: How Heroic Policy Narratives Shape Policy Realities." *Policy Studies Journal* 41 (3): 453–83.

Shanahan, Elizabeth A., Mark K. McBeth, and Michael D. Jones. 2014. "Denouement?" In *The Science of Stories: Applications of the Narrative Policy Framework in Public Policy Analysis*, edited by Michael D. Jones, Elizabeth A. Shanahan, and Mark K. McBeth, 247–60. New York: Palgrave Macmillan.

Shea, Katriona, Hugh P. Possingham, William W. Murdoch, and Rick Roush. 2002. "Active Adaptive Management in Insect Pest and Weed Control: Intervention with a Plan for Learning." *Ecological Applications* 12 (3): 927–36.

Silvis, Virginia G. 2018. "Flooding by Design: A Look at the National Flood Insurance Program." *Risk, Hazards & Crisis in Public Policy* 9 (1): 82–99.

Sinatra, Gale M., and Barbara K. Hofer. 2016. "Public Understanding of Science: Policy and Educational Implications." *Policy Insights from the Behavioral and Brain Sciences* 3 (2): 245–53.

Sklar, Fred H., Michael J. Chimney, Susan Newman, Paul McCormick, Dale Gawlik, ShiLi Miao, Christopher McVoy, et al. 2005. "The Ecological–Societal Underpinnings of Everglades Restoration." *Frontiers in Ecology and the Environment* 3 (3): 161–69.

Smith, Kevin B., and Christopher W. Larimer. 2013. "How Does It Work? Policy Implementation." In *The Public Policy Theory Primer*, 2nd ed., 149–69. Boulder, CO: Westview Press.

Spruijt, Pita, Anne B. Knol, Eleftheria Vasileiadou, Jeroen Devilee, Erik Lebret, and Arthur C. Petersen. 2014. "Roles of Scientists as Policy Advisers on Complex Issues: A Literature Review." *Environmental Science & Policy* 40: 16–25.

Stankey, George H., Roger N. Clark, and Bernard T. Bormann. 2005. "Adaptive Management of Natural Resources: Theory, Concepts, and Management Institutions." PNW-GTR-654. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. https://doi.org/10.2737/PNW-GTR-654.

Starr, Chauncey. 2003. "The Precautionary Principle Versus Risk Analysis." *Risk Analysis* 23 (1): 1–3. https://doi.org/10.1111/1539-6924.00285.

Steinke, Ines. 2004. "Quality Criteria in Qualitative Research." In *A Companion to Qualitative Research*, edited by Uwe Flick, Ernst von Kardorff, and Ines Steinke, translated by Bryan Jenner, 184–90. Thousand Oaks, CA: SAGE Publications Inc.

Stewart, Charles J., and William B. Cash Jr. 2008. *Interviewing: Principles and Practices*. 12th Edition. New York City: McGraw-Hill.

Sunstein, Cass R. 2003. "Beyond the Precautionary Principle." *University of Pennsylvania Law Review* 151 (3): 1003–58. https://doi.org/10.2307/3312884.

Swarzenski, Christopher M., Thomas W. Doyle, Brian Fry, and Thomas G. Hargis. 2008. "Biogeochemical Response of Organic-Rich Freshwater Marshes in the Louisiana Delta Plain to Chronic River Water Influx." *Biogeochemistry* 90 (1): 49–63.

Taal, M. D., M. A. M. Löffler, C. T. M. Vertegaal, J. W. M. Wijsman, L. Van der Valk, and P. K. Tonnon. 2016. "Development of the Sand Motor: Concise Report Describing the First Four Years of the Monitoring and Evaluation Programme." Delft, Netherlands: Deltares.

Teal, John M., Ronnie Best, Jane Caffrey, Charles S. Hopkinson, Karen L. McKee, James T. Morris, Susan Newman, and Bill Orem. 2012. "Mississippi River Freshwater Diversions in Southern Louisiana: Effects on Wetland Vegetation, Soils, and Elevation." Final Report to the State of Louisiana and the U.S. Army Corps of Engineers through the Louisiana Coastal Area Science & Technology Program; coordinated by the National Oceanic and Atmospheric Administration.

Terando, Adam, Lynne Carter, Kristin Dow, Kevin Hiers, Kenneth E. Kunkel, Aranzazu Lascurain, Doug Marcy, Michael Osland, and Paul Schramm. 2018. "Southeast." In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*, edited by David R. Reidmiller, Christopher W. Avery, David R. Easterling, Kenneth E. Kunkel, Kristin L.M. Lewis, T.K. Maycock, and B.C. Stewart, 743–808. Washington D.C.: U.S. Global Change Research Program.

Theriot, Jason P. 2014. *American Energy Imperiled Coast: Oil and Gas Development in Louisiana's Wetlands*. Baton Rouge, LA: Louisiana State University Press.

Thibodeaux, Ron. 2012. *Hell or High Water: How Cajun Fortitude Withstood Hurricanes Rita and Ike*. Lafayette, LA: University of Louisiana at Lafayette Press.

Thorne, Colin, Oliver Harmar, Chester Watson, Nick Clifford, David Biedenharn, and Richard Measures. 2008. "Current and Historical Sediment Loads in the Lower Mississippi River." London: European Research Office of the U.S. Army.

Tidwell, Mike. 2003. *Bayou Farewell: The Rich Life and Tragic Death of Louisiana's Cajun Coast*. New York: Vintage Departures.

Tierney, Kathleen. 2020. "Foreword." In *Louisiana's Response to Extreme Weather: A Coastal State's Adaptation Challenges and Successes*, v–viii. Extreme Weather and Society. Cham: Springer.

Times-Picayune Editorial. 2015. "Oil, Gas Royalties Are a Must for Coastal Restoration." *The Times-Picayune*, September 4, 2015.

Turner, R. Eugene. 2009. "Doubt and the Value of an Ignorance-Based World View for Restoration: Coastal Louisiana Wetlands." *Estuaries and Coasts* 32 (6): 1054–68.

———. 2011. "Beneath the Salt Marsh Canopy: Loss of Soil Strength with Increasing Nutrient Loads." *Estuaries and Coasts* 34 (5): 1084–93. https://doi.org/10.1007/s12237-010-9341-y.

———. 2014. "Diversions Basics - Notes for the Expert Panel." Presented at the Diversion Expert Panel, Baton Rouge, LA, October 28. https://thewaterinstitute.org/assets/docs/reports/Turner_Expectations-of-system-response.pdf.

Turner, R. Eugene, Brian L. Howes, John M. Teal, Charles S. Milan, Erick M. Swenson, and Dale D. Goehringer- Tonerb. 2009. "Salt Marshes and Eutrophication: An Unsustainable Outcome." *Limnology and Oceanography* 54 (5): 1634–42.

Turner, R. Eugene, James M. Lee, and Christopher Neill. 1994a. "Backfilling Canals as a Wetland Restoration Technique in Coastal Louisiana." OCS Study MMS 94-0026. New Orleans, LA: U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region.

———. 1994b. "Backfilling Canals to Restore Wetlands: Empirical Results in Coastal Louisiana." *Wetlands Ecology and Management* 3 (1): 63–78.

Turner, R. Eugene, and Giovanna McClenachan. 2018. "Reversing Wetland Death from 35,000 Cuts: Opportunities to Restore Louisiana's Dredged Canals." *PLoS One* 13 (12): e0207717.

UN. 1995. Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, The Earth Summit Agreement on High Seas Fishing. United Nations, New York, November 1995: 33 pp.

UNEP. 1996. Final Act of the Conference of the Plenipotentiaries on the Ammendments to the Convention for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources. UNEP(OCA)/MED 7/4, United Nations Environment Programme, March 1996.

———. 2019. "Environmental Rule of Law: First Global Report." Nairobi, Kenya: United Nations Environment Programme.

Ungar, Sheldon. 2000. "Knowledge, Ignorance and the Popular Culture: Climate Change versus the Ozone Hole." *Public Understanding of Science* 9 (3): 297–312.

U.S. Army Corps of Engineers. n.d. "History of the Lower Mississippi Levee System." Vicksburg, MS: Mississippi Valley Division, U.S. Army Corps of Engineers. Accessed January 20, 2020. https://www.mvd.usace.army.mil/Portals/52/docs/MRC/MRT_Levees.pdf?ver=2017-07-27-141912-910.

Valentine, Gill. 2005. "Tell Me about ...: Using Interviews as a Research Methodology." In *Methods in Human Geography: A Guide for Students Doing a Research Project*, edited by Robin Flowerdew and David Martin, 2nd Edition, 110–27. Abingdon, Oxford: Routledge.

Visbeck, Martin. 2008. "From Climate Assessment to Climate Services." *Nature Geoscience* 1 (1): 2–3. https://doi.org/10.1038/ngeo.2007.55.

Wall, Tamara U., Alison M. Meadow, and Alexandra Horganic. 2017. "Developing Evaluation Indicators to Improve the Process of Coproducing Usable Climate Science." *Weather, Climate, and Society* 9 (1): 95–107. https://doi.org/10.1175/WCAS-D-16-0008.1.

Walters, Carl, Lance Gunderson, and C. S. Holling. 1992. "Experimental Policies for Water Management in the Everglades." *Ecological Applications* 2 (2): 189–202.

Walters, Carl J. 1986. *Adaptive Management of Renewable Resources*. Caldwell, New Jersey: Blackburn Press.

———. 2007. “Is Adaptive Management Helping to Solve Fisheries Problems?” *AMBIO: A Journal of the Human Environment* 36 (4): 304–7. .

Walters, Carl J., and Ray Hilborn. 1978. “Ecological Optimization and Adaptive Management.” *Annual Review of Ecology and Systematics* 9 (1): 157–88.

Walters, Carl J., and C. S. Holling. 1990. “Large-Scale Management Experiments and Learning by Doing.” *Ecology* 71 (6): 2060–68. https://doi.org/10.2307/1938620.

Wamsler, Christine. 2017. “Stakeholder Involvement in Strategic Adaptation Planning: Transdisciplinarity and Co-Production at Stake?” *Environmental Science & Policy* 75 (September): 148–57. https://doi.org/10.1016/j.envsci.2017.03.016.

Wamsley, Ty V., Mary A. Cialone, Jane M. Smith, John H. Atkinson, and Julie D. Rosati. 2010. “The Potential of Wetlands in Reducing Storm Surge.” *Ocean Engineering* 37 (1): 59–68.

Wells, John T., Loretta Battaglia, Philip Berke, James Boyd, Linda Deegan, William Espey Jr., Liviu Giosan, et al. 2014a. “Expert Panel on Diversion Planning and Implementation - Report #1.” Baton Rouge, LA: Water Institute of the Gulf.

———. 2014b. “Expert Panel on Diversion Planning and Implementation - Report #2.” Baton Rouge, LA: Water Institute of the Gulf.

———. 2015a. “Expert Panel on Diversion Planning and Implementation - Report #3.” Baton Rouge, LA: Water Institute of the Gulf.

———. 2015b. “Expert Panel on Diversion Planning and Implementation - Report #4.” Baton Rouge, LA: Water Institute of the Gulf.

———. 2015c. “Expert Panel on Diversion Planning and Implementation - Report #5.” Baton Rouge, LA: Water Institute of the Gulf.

———. 2016a. “Expert Panel on Diversion Planning and Implementation - Report #6.” Baton Rouge, LA: Water Institute of the Gulf.

———. 2016b. “Expert Panel on Diversion Planning and Implementation - Report #7.” Baton Rouge, LA: Water Institute of the Gulf.

Whyte, William Foote. 1982. “Interviewing in Field Research.” In *Field Research: A Sourcebook and Field Manual*, edited by Robert G. Burgess, 170–88. London: Allen and Unwin.

Wilhere, George F. 2002. "Adaptive Management in Habitat Conservation Plans." *Conservation Biology* 16 (1): 20–29. https://doi.org/10.1046/j.1523-1739.2002.00350.x.

Williams, Byron K. 2011a. "Adaptive Management of Natural Resources—Framework and Issues." *Journal of Environmental Management* 92 (5): 1346–53.

———. 2011b. "Passive and Active Adaptive Management: Approaches and an Example." *Journal of Environmental Management* 92 (5): 1371–78. https://doi.org/10.1016/j.jenvman.2010.10.039.

Williams, Byron K., and Fred A. Johnson. 1995. "Adaptive Management and the Regulation of Waterfowl Harvests." *Wildlife Society Bulletin (1973-2006)* 23 (3): 430–36.

Williams, Richard N., ed. 2006. *Return to the River: Restoring Salmon to the Columbia River*. Burlington, MA: Elsevier Academic Press.

Williams, S Jefreess. 1995. "Louisiana Coastal Wetlands: A Resource at Risk USGS Fact Sheet." United States Geological Survey.

Willoughby, Urmi Engineer. 2018. "Epidemics, Empire, and Eradication: Global Public Health and Yellow Fever Control in New Orleans." In *Environmental Disaster in the Gulf South; Two Centuries of Catastrophe, Risk, and Resilience*, edited by Cindy Ermus, 37–61. Baton Rouge, LA: Louisiana State University Press.

Wissmar, Robert C., and Peter A. Bisson, eds. 2003. *Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed System*. Bethesda, MD: American Fisheries Society.

Wold, Amy. 2012. "Protective Pattern, Master Coastal Plan Called Realistic." *The Advocate*, January 13, 2012.

———. 2014. "Delta Dawns at Wax Lake Outlet, Unintended Merging Mud Flats Show Promise of Diversion Projects." *The Advocate*, July 30, 2014.

———. 2016. "Spending, Erosion Are Top Priorities, New Leaders Talks Deepwater Settlement, River Diversions." *The Advocate*, February 25, 2016.

Young, Nathan, Vivian M. Nguyen, Marianne Corriveau, Steven J. Cooke, and Scott G. Hinch. 2016. "Knowledge Users' Perspectives and Advice on How to Improve Knowledge

Exchange and Mobilization in the Case of a Co-Managed Fishery." *Environmental Science & Policy* 66 (December): 170–78. https://doi.org/10.1016/j.envsci.2016.09.002.

Zebrowski, Ernest, and Mariah Zebrowski Leach. 2014. *Hydrocarbon Hucksters: Lessons from Louisiana on Oil, Politics, and Environmental Justice*. Jackson, MS: University Press of Mississippi.

Zellmer, Sandra, and Lance Gunderson. 2008. "Why Resilience May Not Always Be a Good Thing: Lessons in Ecosystem Restoration from Glen Canyon and the Everglades." *Nebraska Law Review* 87 (4): 893–949.

Ziervogel, Gina, Emma Archer van Garderen, and Penny Price. 2016. "Strengthening the Knowledge–Policy Interface through Co-Production of a Climate Adaptation Plan: Leveraging Opportunities in Bergrivier Municipality, South Africa." *Environment and Urbanization* 28 (2): 455–74. https://doi.org/10.1177/0956247816647340.

Zinn, Matthew D. 2002. "Policing Environmental Regulatory Enforcement: Cooperation, Capture, and Citizen Suits." *Stanford Environmental Law Journal* 21 (1): 81–176.