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Environmental Management in Coastal Louisiana: A Historical Review

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ABSTRACT

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A series of state and federal environmental management policies have been implemented in Louisiana's coastal region over the last several centuries that have directly affected vulnerable coastal residents. The policies have shifted primary attention from flood protection, to wetlands reclamation, to wildlife conservation, to wetlands restoration. Adoption and implementation of these policies have seldom factored in the impacts of management regimes on the coastal society. This paper reviews the changing environmental management regimes, how they have affected access to natural resources in the region, the adaptations made by resource-dependent societies in response to these management changes, the role of public engagement in planning environmental management, and the lack of provisions in the plans to accommodate the human adjustments they impel.

ADDITIONAL INDEX WORDS: *Flood protection, wetland reclamation, conservation, wetland restoration, social impact*.

INTRODUCTION

Most of Louisiana's coastal population qualifies as vulnerable by prevailing definitions (Cutter,1996; Oxfam, 2012). For many years, economically, linguistically, politically marginalized communities of Native Americans, Acadians, Isleños, Asians, and African Americans have adapted to a combination of slow-moving, natural and human-induced environmental changes and rebounded from irregular extreme events such as tropical cyclones, river floods, and oil gushers as they have maintained a surprisingly resilient society.

Managing the wetland environment that is their home and source of livelihood is a human endeavor, but the responsible government bodies sometimes carry out their task as if the environmental processes they direct were detached from the local society. Policies often obscure the biophysical interventions of engineers and scientists from the ensuing consequences that the residents of the region must live with despite the growing recognition of the many linkages between natural systems and human communities. This paper reviews the changing management regimes in coastal Louisiana, their impacts on public access to resources once held in common, the adaptations made by families engaged in resource-based economies, the role of public participation in environmental management, and the introduction of new human-environment relationships that have prompted human adaptations without including adequate provisions for those adjustments. This is not a review of biophysical changes, but of the social processes humans use to manage the biophysical environment and accommodate the ensuing social changes.

BACKGROUND

Coastal Louisiana has been subject to several prominent environmental management regimes over the last three centuries, and each has influences on and is influenced by natural changes (Figure 1). The first, and the one with continuing effects, is flood protection. From early colonial settlement, levee construction to fend off high water has transformed the local environment to protect riparian residents and businesses from inundation. Wetland reclamation, the next tactic, sought to remove moisture from the extensive marshes and swamps that were considered wastelands and convert them to productive farm land. This approach arose as a form of public and private environmental management in the late 19th century and continued well into the 20th century. Conservation practices emerged in the early 20th century and drove government involvement in the protection of certain wildlife species and other natural resources. Over the past several decades, restoration has emerged as the dominant management regime. It seeks to re-establish wetlands to a condition that will protect the region's ecology and major economic interests in the state. Each of these regimes has a

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Figure 1. The Louisiana coastal region contains two major wetland plains: the deltaic and chenier plains. Several major rivers pass through these coastal wetlands, and human settlements cluster on the slightly higher ground of natural levees. Cartography by Mary Lee Eggart.

strong science or engineering foundation and seeks to produce predetermined ecological outcomes. They are not directed toward human communities. Yet, as Ludwig and others noted in the 1990s, environmental management is a human undertaking—that is, humans make the decisions and guide efforts to manage nature, and humans live with the consequences (Ludwig, Hilborn, and Walters, 1993). Despite procedures and promises of public involvement, policy makers with a focus on the biophysical environment often neglect the effects of the programs on the very population most affected.

The early management policies took form in an era of more traditional public hearings and before environmental and social impact assessment. Their single-purpose designs restricted the vision of engineers and scientists to addressing the primary objective, whether it was flood protection, converting wasteland to productive real estate, or species perpetuation. Since the implementation of the environmental impact assessment procedures in the 1970s, recognition of the interrelationships among the many ecological systems and society has become more pronounced. Additionally, ecological science has acknowledged the prominent role of humans in environmental change (Balee, 1998; McNeill, 2001). Critics of current practices note that social impacts remain a secondary consideration, particularly in relationship to coastal management (Vanclay, 2012). Additionally, there are those who argue that ecological restoration, the most recent management regime, should seek to restore not only the biotic, geologic, and hydrologic environment, but the social-economic ecology as well (O'Brien and McIvor, 2007). This objective would require a more exhaustive analysis of both the human past and social trends within the local environmental setting. Yet, there is seldom documentation and analysis of the social and cultural circumstances before and after the environmental change that is comparable to the research on the biophysical phenomena. This undermines the premise that "restoration cannot proceed without recognition of human impacts and cultural significance . . . [that] historical fidelity is as important as ecological integrity" (Guerrini and Dugan, 2010, p. 133; Higgs, 2010). Desbiens (2013) argues that sustainable resource management, a goal of many current plans, demands collaborative development of project goals. Collaboration demands equity and reciprocity in understanding both the linked human-environmental factors and the viewpoints of all who interact with a managed landscape. To achieve the ambitious goal of mutual restoration of the ecology and society, robust public participatory methods that foreground local social and cultural experts as full partners is essential in analysis and planning. According to this line of thinking, it is important to incorporate public desires and to involve people beyond the expert science and engineering community in the process, and those beyond elected officials and agency personnel, and to factor in the effects of environmental management on society.

It is well known by social scientists that the human communities in coastal Louisiana are at risk and that they compose an important resource themselves (Gramling and Hagelman, 2005; Laska *et al.,* 2005). Historical management regimes, implicitly, have expected residents of the floodplain or coastal wetlands to adapt to changing environmental conditions while making few provisions for those changes. Despite their marginalized social position, Louisiana's coastal residents have demonstrated an array of resilient practices that have enabled them to persist in place—adapting to both natural and human-driven change. Three principal adaptive mechanisms undergird their resilience: social networks or social capital, mobility, and ingenuity (Colten, Grismore, and Simms, 2015; Colten, Hay, and Giancarlo, 2012). Social capital embodied in family, ethnic, and religious support networks has enabled those engaged in natural resource–based livelihoods to withstand both ecologic and economic disruptions. Likewise, mobility—both economic and geographic—has provided a means to escape disruptive conditions and secure an alternative source of livelihood. Finally, ingenuity or creativity has

furnished a means to apply skills and techniques intended for one purpose to a different set of circumstances. As a consequence of alterations caused by different environmental management regimes, along with on-going natural change, coastal residents are now adapted to current conditions vastly different from the conditions faced by their ancestors. Current coastal restoration plans contain no explicit reference to the fact that environmental modifications they contribute to will compel still another round of adaptations that may or may not complement existing cultural and social practices (CRCL, 1987; LCWCRTF, 1998; CPRA, 2012). These plans have the potential to collide with historically rooted and culturally perpetuated notions of exclusion among coastal residents.

COMMONS, RESTORATION, AND SOCIETY

Before European colonization of the Louisiana coast, Native Americans followed the gradual growth of the deltas as they extended into the gulf. They adapted to continually changing environmental conditions and treated the landscape as a common resource. When French settlers arrived in Louisiana in the early 18th century, the French explorer Robert de La Salle had already staked an imperial claim to the entire Mississippi River valley, thus superimposing royal authority on pre-existing indigenous lands. Colonial officials, both French and later Spanish, granted lands to settlers and considered the unsettled lands and waters as commons. Over time, the commons has been narrowed by public policy. Europeans arrived with concepts of two types of commons: the more intensively used agricultural commons and the so-called wastes, or less-used peripheral territory (Greer, 2012). Much of the land beyond the crown's grants atop the natural levees in colonial Louisiana fell into that latter category. These "wastes" were the swamps and marshes that constituted the landscape of much of the territory's coastal fringe. Landowners could harvest cypress in these lands, enslaved laborers often hunted and fished the unbounded territory, and some escaped African Americans used this space for clandestine settlements. Additionally, landowners, both large and small, grazed cattle in the unclaimed marshes. Thus the commons provided a valuable resource used by all segments of society.

Increasingly, land moved from public to private ownership and thereby reduced the terrestrial commons. Private landowners acquired the vast majority of Louisiana's coastal wetlands. Also, after the Louisiana Purchase in 1803, U.S. policy began shifting the orientation of public lands policy from the commons to commodities (Wilson, 2014). A series of legislative and regulatory actions aimed at flood protection and maintaining selected species of wildlife and other resources restricted legal access to public lands. These adjustments had clear effects on the natural resource–based society in south Louisiana, although the plans did little to assist with social adjustments demanded by the policies. With each change, people in Louisiana's coastal margins drew on their resilient capacities to adapt to new conditions (Colten, Grismore, and Simms, 2015).

A related series of federal environmental protection policies enacted in the 1960s and 1970s sought to address fears engendered by the so-called "tragedy of the commons." Garrett Hardin's landmark article on this subject in 1968, prompted the public and policy makers to think of the environment as something more than personal property and economic resources (Hardin, 1968). Rather, the environment had value in its own right. And since all members of society shared it, they also bore a joint responsibility to protect it. While this idea was a powerful influence in the post-1960s environmental movement, this paper, in order to trace changing management regimes before and after Hardin's work, follows historians' usage of the term in reference to access to public lands (Greer, 2012; Wall, 2014).

FLOOD PROTECTION

The first major environmental management policy centered on protecting the tenuous settlement of New Orleans from regular flooding. Colonial policy as early as 1723 provided for the erection of levees around the emerging city and required landowners beyond the city to build levees along their river frontage. Essentially a form of *corvée* labor, this policy subjected private landowners to the dedication of a portion of their private land to the protection of the larger public (Colten, 2005). The batture, or the narrow swath of land between the levees and the river itself, remained a commons, and urban dwellers were able to scavenge sediment from the riverfront to fill their low-lying lots in the city (Kelman, 2003).

After France sold the Louisiana Territory to the United States in 1803, a series of policies impinged on common use of the river and riparian lands. New Orleans imposed a tax on boats tying up along the waterfront. Collected to pay for levee maintenance, the tax policy recognized the batture as public land, but enabled the city to place a cost on its use (Colten, 2005). Also under U.S. authority, the state created levee districts. These bodies did not own land, but were semiautonomous government authorities that could impose taxes on landowners within their jurisdiction and apply those revenues to building and maintaining levees (Owens, 1999). By the mid-19th century, the U.S. government transferred millions of acres of swamplands to states like Louisiana and Florida. The intent of this action was to permit the states to sell the "wastelands" and use the proceeds to build and maintain effective levees without tapping the federal coffers. For this system to work, it necessitated the sale of public lands to individuals or companies. With transactions of this sort, the vast wetlands of the interior swamps and coastal marshes would become less accessible to hunters, trappers, and fishermen (Colten, 2014b). Despite poachers continuing to harvest cypress, sale of land to large timber companies after 1870 limited legal access to the wetland forests. Near complete removal of the rich cypress stands by the 1930s disrupted traditional resource collection practices in the Atchafalaya basin.

After the American Civil War, the U.S. government gradually assumed responsibility for levee building in the lower river. With the creation of the Mississippi River Commission in 1879, federal authorities undertook a more systematic program of levee building that involved enlarging the footprint of the barriers and encroached on private land. Granted, the initial federal involvement in levee building was explicitly for the purpose of enhancing navigation. Although local interests sought to prevent inundation, federal funds were provided to foster interstate commerce. Thus, levees thoroughly inter-

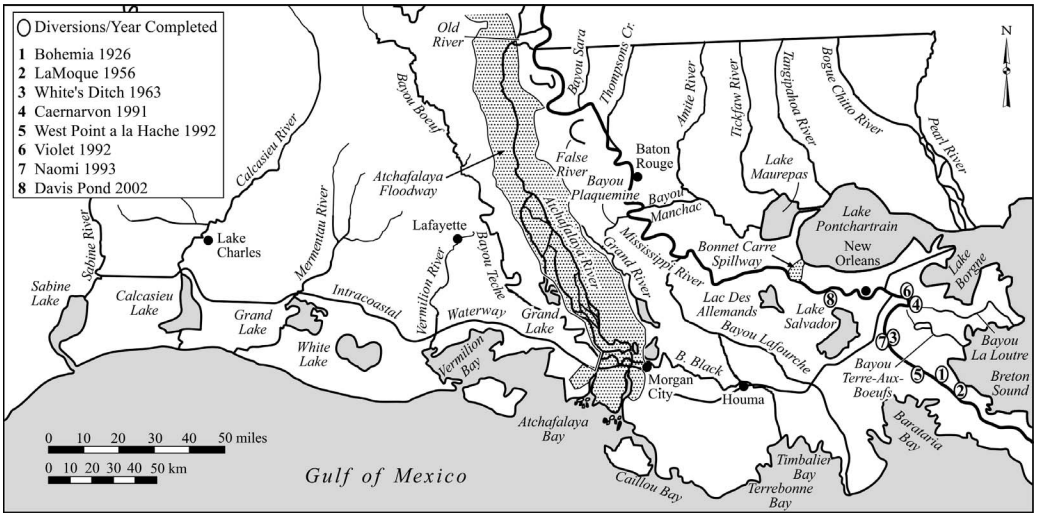

Figure 2. Historical diversions and spillways on the Mississippi River. Since the 1920s, several efforts have been made to reconnect portions of the coastal wetlands adjacent to the Mississippi River with freshwater diversions. The construction of two major flood control outlets after the 1927 flood provided occasional relief from high water. Cartography by Mary Lee Eggart.

twined flood protection and navigation concerns (O'Neill, 2006).

After the great flood of 1927, federal policy shifted to include "outlets" or engineered floodways to carry large volumes of floodwater to the Gulf of Mexico via designated channels (Camillo and Pearcy, 2004; Reuss, 1998). Central to this discussion were contrasting viewpoints: create a diversion to send a portion of the river down the natural distributary, the Atchafalaya River, or raise the levees below that waterway's source. There were public hearings on the changing policy, and landowners in the Atchafalaya basin objected to the use of diversions to protect New Orleans from flooding (Mississippi River Commission, 1927). Ultimately, the outlets argument prevailed in the interest of protecting the shipping infrastructure and dense urban population at New Orleans. By the 1950s, it also became apparent that control structures as part of this diversion were necessary to prevent the Atchafalaya from capturing the Mississippi. Consequently, the outlet option became even more essential (Reuss, 1998).

The Corps completed the Bonnet Carré spillway by 1931 to divert excess flow through Lake Pontchartrain to the Mississippi Sound and launched planning and design work for the larger Atchafalaya Spillway (Figure 2). As flood control projects moved forward, the increasing volume of Mississippi River water and sediment flowing through the Atchafalaya River basin contributed to the silting of large inland lakes (Reuss, 1998). These lakes were major commercial fishing areas and fishermen treated their waters as a commons (Comeaux, 1972). By the time the Atchafalaya Spillway was operational in the 1950s, the commercial fishing activities on Grand Lake had largely disappeared due to sedimentation in the waterbody.

Oystermen in Mississippi, as early as 1923, voiced concern about a potential diversion that would reroute river water through Lake Pontchartrain into their prime oyster grounds. Meanwhile, fishing industry trade organizations indicated they approved of the spillway with the stipulation that it would not injure oyster beds in Mississippi waters (Krebs, 1923). When the Bonnet Carré spillway was opened to its full flow for the first time in 1945, there was extensive damage to the oyster beds in Mississippi Sound and resounding criticism from the fisherfolk. The increased flow through the Atchafalaya also damaged coastal fishing in 1945 (Delacruz *in* U.S. Congress, House of Representatives, 1946, pp. 23–24) and again when the spillway was opened for the first time in 1973 (Gulf South Research Institute, 1973). Damage to the Mississippi Sound fisheries followed the spillway opening in 2011 (USACE, 2012). Thus, the use of outlets has had repeated, episodic economic impacts on resource-based societies. Despite damages to oysters and objections against this environmental management approach by fisherfolk, planners prioritized protecting New Orleans and shipping infrastructure, and the outlets remain in place for occasional use in the interest of flood control without standing authorization for compensation for occasional damages to fishermen's livelihoods.

The construction of levees and outlets—along with numerous other influences such as navigation canals, agricultural chemicals, and intensive resource use—has also contributed to an entirely reconfigured coastal ecology. No longer do annual floods spread across the lower delta and add sediment to the wetlands. Rather, levees confine the sediment and direct it into the deep waters of the Gulf. This arrangement has created a new ecology for shrimp, oysters, and other wildlife in the coastal estuaries and an ecology without the annual pulses of freshwater. Individuals pursuing natural resource-based livelihoods have adapted to this somewhat predictable, albeit human-induced, pattern. Oyster leases and investments in fishing infrastructure reflect the current conditions and create a social inertia against rapid change.

WETLAND RECLAMATION

American agricultural policy in the 19th century promoted wetland reclamation. Engineering expertise and existing technologies enabled entrepreneurs to remove water from these "wastelands" and convert them to productive agriculture. Congress passed the Swamp Lands Acts of 1849 and 1850, and this legislation represented a major step in this direction by transferring massive amounts of wetlands to states as an indirect subsidy for flood protection. The idea behind the Acts was that states could sell the property for agricultural development and use the proceeds for flood protection. The reclamation spirit was shared by the American Society of Civil Engineers, which touted reclamation of Louisiana's delta and coastal marshes for rice cultivation (Corthel *et al*., 1852). Yet neither Louisiana nor Florida were able to convert sizable wetland tracts to agriculture by the mid-19th century. Much of the 10 million acres transferred to Louisiana remained part of the commons through the Civil War and remained undeveloped wetlands (Blake, 1980; Norgress, 1947).

Undeterred by a lack of actual land drainage, the U.S. Department of Agriculture (USDA) resumed the campaign in the later years of the century. It noted the extensive coastal wetlands in the country and promoted their development as pasture and cropland. The report's author challenged some of the prevailing objections raised about wetland reclamation by pointing out that it was both technologically practical and economically feasible. The rich soils of these undeveloped wetlands, the agency argued, offered great potential for expansion of agriculture and resource development as comparable opportunities receded on the western frontier (Nesbit, 1885). Public spokespeople continued to advocate for wetland drainage, specifically in Louisiana. A 1914 USDA bulletin (Okey, 1914) noted that about a third of Louisiana was wetland and that levee protection precluded annual inundation, thus making reclamation feasible. A thorough review of several existing reclamation projects, along with climatic and hydrologic conditions in the state, led the author to conclude that pump drainage of wetlands was a viable option and that existing projects had proven successful. With levees in place that enabled reclamation and concerns about the exhaustion of most other public lands in the state, the author advocated for further reworking of Louisiana's marshes (Okey, 1914). Overall, reclamation was a focused effort of re-engineering specific parcels of the environment, and the USDA did not mention that the reclamation projects would displace many wetland livelihoods (Comeaux, 1972). Nor did government bodies hold hearings on the private projects. Entrepreneurs built levees, drained the wetlands, and displaced traditional livelihoods without soliciting the opinion of commercial fishermen, hunters, or trappers.

By the late 1940s, however, reclamation had lost most public support. Several drainage projects in Louisiana had proven unsuccessful. Land speculators were the primary operators of land reclamation districts, which required state approval, during the early 1900s, and they drained some 240,000 acres. By midcentury scientists recognized that subsidence of coastal lands was occurring, rendering levees built to keep out storm surge less effective over time (Harrison and Kollmorgen, 1947). Storm surge flooded some of the projects and prompted the withdrawal of financial backing. Additional maintenance costs, such as increased pumping to keep pace with subsidence after drainage and with the need to dredge the internal drainage canals frequently, along with poor management of drainage districts, led to their eventual failure. Project investors had targeted farm families in the Midwest as customers and seldom sought to sell to local farmers. Despite limited cultivable land on the natural levees, speculative projects did not include residents whose local knowledge and family networks may have provided a cushion against failure. Furthermore, these projects excluded traditional market hunters, trappers, and fishermen from the wetland commons, and they transformed wetland habitat, at least temporarily, into dry lands, further interfering with resource-based livelihoods. In the long run, none proved successful as agricultural projects, and several became hunting clubs for urban sportsmen, not local hunters (Harrison and Kollmorgen, 1947).

CONSERVATION

Fear of resource exhaustion across the country provided a compelling argument for the emerging ideas of conservation in the late 19th century. As Samuel Hays (1959) argues, conservation, or managed, wise use of resources, was at its core a "scientific movement." Application of sound science could offset the depredations of ravenous and unchecked wildlife hunting and fishing, timber removal, and mineral extraction and sustain the yields of natural resources that society desired. Conservation was presented in terms of opportunity, not limitations. Management of forest resources would ensure a dependable timber supply, and likewise limitations on fishing and hunting would halt destructive practices and assure future harvests. Restrictions impinged directly on the commons and traditional livelihoods—some of which threatened wildlife populations. Conservation policies sought to reverse unregulated depletion of resources, examples of tragedy of the commons, but regulations made no accommodation for social transitions necessitated by regulatory changes.

Louisiana, as other states at the time, moved gradually to implement conservation policies. As early as 1877, the legislature granted parishes (counties) the authority to set aside wildlife preserves, although none took action to do so (Louisiana Commission of Birds, Game and Fish, 1910). In 1908 through 1910, the state took more assertive action. It created a Commission for the Protection of Birds, Game and Fish in 1908 (Act 278); declared waters of bayous, lagoons, lakes, bays, and rivers property of the state (Act 258); took steps to regulate shrimping in the coastal bays; and established fish and game preserves (Louisiana Commission of Birds, Game and Fish, 1910). Over the next several years, the state imposed numerous conservation-oriented limits on hunting and fishing seasons and techniques, all with the intent to manage wildlife populations. Couched in terms of wise use and scientific management, these policies gained political support outside the wetlands region when state authorities characterized market hunters and commercial fishermen as a menace to wildlife and fish populations (Louisiana Commission of Birds, Game and Fish, 1910). Additionally, private citizens and national charitable organization set aside sizable tracts of

wetlands as wildlife preserves, which eventually became the core of the state and federal wildlife refuge program (Gomez, 1998; McIlhenny, 1928). Under a mix of private, state, and federal ownership, more than 920,000 acres of protected wetlands in Louisiana's coastal parishes today have some degree of conservation-oriented limited access. They have contributed to the successful perpetuation of waterfowl for sport hunters, as well as alligators.

Depletion of oysters presented another serious problem, and the state followed the lead of other states by created a leasing system that made oyster production mariculture. As with its initial efforts to conserve other natural resources, the state initially delegated authority to the parishes, but an 1898 federal study of the oyster population exposed ineffective management by the local authorities (Moore, 1898). To counter this situation, the state created an oyster commission in 1902 to oversee the conservation of this valued commodity. It established a system that allowed oyster gatherers to secure leases of water bottoms from the state and work these beds as if they were private property. They had exclusive rights to the harvest and in theory would be good stewards if they managed their leases for continued income. Dyer and Leard (1994) argue that the oystermen's support of the leasing system in Louisiana has been effective (Maass, 2014; Wicker, 1979). In 2005, more than 400,000 acres of state water bottoms were under lease and reflect a collaborative approach.

The transition to conservation practices was not without difficulty for oystermen. Fishermen and the state recognized that levees prevented annual freshwater flushing to the coastal marshes, which raised salinity levels and damaged oysters by 1914. The state, at the request of oystermen, constructed a series of freshwater siphons and other structures between the 1920s and the1960s that offset the combined effect of salinity and fixed leases (Figure 2) (McGuire, 2008). By the 1950s, however, further analyses had identified land loss and salinity changes because of levees as significant processes forcing geographic shifts in oyster production in the state's coastal bays (Schlesselman, 1955). Oystermen have had a prominent voice in environmental management practices that has produced mixed results.

In the long term and with considerable federal assistance, the state's conservation measures restored populations of waterfowl and alligators in the coastal margins. Yet, as the state implemented its policies, other than oystermen, those who either benefited or endured the effects of these policies had limited opportunity to voice their opinions on how the procedures were put into place. As in other parts of the country, conservation efforts were guided by elite citizens, often hunters and fishers, and state officials. Edward McIlhenny, a prominent landowner and businessman, was a powerful advocate and influential voice for conservation in Louisiana (McIlhenny, 1928). McIlhenny, along with public officials, wrote disparagingly about the traditional resource gatherers and identified them as contributing to the problem. Sport hunters and fishermen pushed for new conservation management policies. McIlhenny, in collaboration with wealthy sportsmen from outside the region and the state, actively participated in creating wildlife preserves in the coastal region that precluded market hunting, trapping, and oyster harvesting. Furthermore, state policies limited fishing and hunting seasons, thereby removing the temporal flexibility that resource gatherers had previously relied on (Louisiana Commission of Birds, Game and Fish, 1910). Granted these efforts served the public good by reducing pressure on wildlife but presented challenges to resource-dependent residents. Inclement weather or other vagaries were irrelevant to the conservation calendar. Even after a tropical cyclone that kept fishers or hunters at home during a key period of the season, they were not allowed to "catch up" after the disruption. With little voice in the process, commercial fishermen, hunters, and trappers found these policies disruptive to their traditional livelihoods. Their recourse was to continue hunting and fishing in open resistance to the regulations and, in some cases, to unleash violence against game wardens. In at least one case hunters, in defiance of state policy, shot and wounded a game warden attempting to enforce state regulations in 1918 (McIlhenny, 1918).

State officials applied conservation policies to shrimping as well. They had the authority to close certain areas to shrimping during specified seasons, again limiting access to the commons (Tulian, 1921). Additionally, regulations set minimum size requirements for shrimp and set specifications for nets. By the 1920s, the state prohibited out-of-state fishermen from working Louisiana waters (Marks, 2012). These restrictions impinged on the mobility or adaptive capacity of those pursuing natural resource–based livelihoods and prompted legal challenges (Louisiana Commission for the Protection of Birds, Game and Fish, 1912; McIlhenny, 1918; Tulian, 1921). Additionally, fishermen formed unions to improve their bargaining power. Changing technologies, high fuel prices, and global competition have accounted for some of the greatest pressures on shrimp fishermen in the 21st century, but conservation policies continue to frame how and when they can pursue their livelihoods (Marks, 2012).

Commercial fishing on the inland waters has declined precipitously, with the exception of crawfishing, and market hunting and trapping have nearly ceased. Conservation policies did restore alligators and enable the resumption of trapping these large reptiles, but trapping of fur-bearing animals has declined, mainly because of changing fashion demands and the market for furs. Introduction of the exotic fur-bearing nutria to Louisiana marshes by trapping interests has produced serious impacts to marshland and prompted the state to offer a bounty for these rodents. Conservation policies, which geographically fixed the operations of oystermen and eliminated their mobility, endowed them with effective property rights that enabled legal action against oil companies that had damaged their leases with canals, pipelines, or pollution. In some cases, courts awarded them money for damages that resulted from extractive activities. Some oystermen gained additional income either by conducting assessments of leases before oil-related activity or collecting payments from oil companies when their operations traversed unproductive leases (Maass, 2014; Theriot, 2014). The overall importance of Louisiana's natural resources and their fundamental social and cultural significance were not factored into contemporary appraisals (Viosca 1928).

Conservation policy also accommodated the emerging oil and gas industry—another commodity that fell under wise-use principles (Banta, 1981; Gorman, 2001). Conservation principles shaped the state's severance tax on oil and gas and its early policies calling for restoration of wetlands disturbed by canals (Banta, 1981). Royalties yielded substantial income for the state, although they did little to impede the near depletion of onshore oil reserves by the 1970s. Thousands of miles of canals dredged in the wetlands to enable mineral exploration and extraction remain a lasting impact of policies that promoted oil and gas activity. These waterways, along with other transportation canals, have contributed to the loss of coastal wetlands. Despite recognition of wetland damages by the early 1950s, canal excavation and use faced little regulation until the 1980s (Houck, 2015; Scaife, Turner, and Costanza, 1983).

ECOLOGICAL RESTORATION

Ecological restoration, according to historian Laura Martin (2015), emerged from conservation practices dating back to the 1930s. Yet most ecologists would point to the formation of the Society for Ecological Restoration in 1987 as the genesis of this approach to environmental management. Despite a rich history, restoration scientists tend to treat it as ahistorical, and few environmental historians have delved into its origins and evolution (see Hall, 2010). Regardless of the moment of its inception, ecological restoration has become the most prominent guiding force in stabilizing and reversing land loss in south Louisiana since the 1980s—a process the state characterizes as its "coastal crisis" (CPRA, 2012). At its core, restoration assumes a mission to reverse the degradation of prior regimes.

Defined as the practice of re-establishing a particular community of species and landscapes that have been damaged, often through human agency, restoration relies on extensive ecological, hydrological, and geological analysis of past and current conditions and modeling of future conditions to design a path toward rehabilitation. Although subsidence in coastal Louisiana had been acknowledged for over a century (Corthell *et al*., 1852; Morgan and Larimore, 1957), discussions about taking action to halt this situation and restore the coast was a late 20th century development. Studies in the 1970s and 1980s provided detailed assessments of the rate of land loss that went far beyond the early observations of subsidence (Gagliano, Meyer-Arendt, and Wicker, 1981; Gagliano and Van Beek, 1970; Penland and Boyd, 1981) and re-defined this region as a damaged territory. The disappearing Louisiana coast and a desire to restore the littoral landscape became the rallying cry for both scientists and citizen activists in the late 1980s. The first restoration plan emerged from an organization known as the Coalition to Restore Coastal Louisiana (CRCL), an agglomeration of scientists, citizen activists, fishermen, and public officials. The plan called for three principal related actions: enhancement of freshwater and sediment into the coastal marshes, repair or restoration of disturbed wetland and barrier islands, and the phase out of canal construction in the coastal zone (CRCL, 1987). The initial report recognized the interconnected environmental and social systems and emphasized the need to restore the region's ecology, which would in turn sustain fisheries and other wetland livelihoods. It also pointed out that historical policies prioritized flood control and navigation and tolerated largely unchecked scarring of the wetlands with canals dredged by mineral companies. This assignment of responsibility is an important indicator in subsequent plans. Past policies had greatly accelerated damage to the naturally subsiding coastal territory. This situation was, in the eyes of the Coalition, a human-damaged environment that demanded ecological restoration relying on science.

Despite the obvious recognition of the relationships among the ecological conditions, the resource-based economies, and the prevailing management strategies, early efforts to launch restorative programs focused on ecological communities. Even a report offering a plan to ensure "continued existence of [Louisiana's coastal region's] unique culture and heritage" included only scanty commentary on the region's economy and nothing on its cultural heritage (Van Heerden, 1994). Project reports, prepared by scientists in an era before participatory science practices, noted that meaningful restoration would require manipulation of biophysical processes at work in the coastal zone (Hebert 1996; LCWCRTF, 1998). Considerable policy adjustments and significant funding would be necessary to set those restoration processes into motion. Initial federal legislative efforts proved unsuccessful, but they revealed a strong sentiment among Louisiana government officials that navigation and oil and gas activities were major contributors to the problem. Virginia Van Sickle, Secretary of the Louisiana Department of Wildlife and Fisheries, testified to Congress in 1989 that "thousands of miles of oil field canals have directly destroyed our wetlands" (Van Sickle *in* U.S. Congress, Senate, 1989, p. 72; Soileau *in* U.S. Congress, Senate, 1989, pp. 75–76).

Efforts to assemble a federal program to fund wetland restoration achieved success in 1990 with the passage of the Coastal Wetlands Planning, Protection, and Restoration Act (2015). In hearings before the House of Representatives, members of the Louisiana congressional delegation and a representative for the CRCL identified the principal causes of the land loss as levee building for flood protection and navigation and the extensive canal networks excavated for mineral extraction (Boggs, Kemp, and Tauzin *in* U.S. Congress, House of Representatives, 1990, pp. 6–8, pp. 26–28, and pp. 12–15, respectively). The Act provided a dedicated funding stream and formalized restoration as part of the environmental management strategy, and it has funded more than 100 restoration projects. It defined coastal restoration projects as "any technically feasible activity to create, protect, restore, or enhance coastal wetlands through sediment or freshwater diversions, water management, or other measures. . ." (U.S. Congress, House of Representatives, 1990, p. 96). In addition to specifying the ecological value of wetlands, the Act specifically noted their value "forming barriers to waves and erosion and helping to reduce flood damage" (Coastal Wetlands Planning, Protection, and Restoration Act *in* U.S. Congress, House of Representatives, 1990). By adding flood protection as a benefit, the legislation gained additional support from urban areas and other states.

A series of restoration plans since the early 1990s have prioritized science-based ecological restoration as the centerpiece of wetlands management (CPRA, 2007, 2012; LCWCRTF, 1993, 1998; USACE, 2004). Each successive plan, using

updated information, has emphasized the perilous situation facing the coast and how, without restoration, the coastal economy will fail. The CRCL and the 1990 Coastal Wetlands Planning, Protection, and Restoration Act had identified levees and loss of regular sediment delivery to the marshes, along with the extensive canal system carved through the marshes as the primary causes of damage. These recent plans and supportive legislation have gradually shifted primary culpability for the problem and reclassified those responsible for land loss in the initial plans as those needing protection—a reflection of the expanded opportunities for public input.

Coast 2050 (LCWCRTF, 1998) drew on the input of not just scientists and engineers but a total of 65 public meetings and unanimous support from parish officials. The public engagement process focused on public officials, and the science lacked a public participatory process. The authors of the 1998 plan had much more scientific analysis to consider, and portrayed land loss as a complex phenomenon that included subsidence, sediment starvation, faulting, sea-level rise, altered hydrology, and storms. Complexity obscured the previous focus on navigation and canal construction and combined them as "altered hydrology." Natural factors such as subsidence, erosion, and faults gained increased attention (LCWCRTF, 1998). With extensive analyses of geologic and hydrologic conditions, the plan's emphasis was decidedly on biophysical aspects of the problem. One chapter reported on potential economic, demographic, and infrastructure impacts, but did not consider cultural losses. The plan was light on its consideration of cultural loss in the coastal region.

When Congress considered reauthorizing the Coastal Wetlands Planning, Protection, and Restoration Act in 1999, the Senate committee noted the cause of land loss: "The current high rate of wetlands loss is a result of the great decrease in sediment deposition while subsidence has remained constant" (U.S. Congress, Senate, 1999, n.p.). Canals and navigation oriented alteration of the Mississippi River and wetlands disappeared from the formal public discussion. Louisiana's primary coastal official, Len Bahr, emphasized the value of wetlands for protection from tropical weather: "The loss of Louisiana coastal wetlands threatens coastal infrastructure, harms wildlife populations and increases the vulnerability of Louisiana cities to devastating hurricane damage" (Bahr *in* U.S. Congress, Senate, 1999, n.p.). Sediment starvation and flood and storm protection rose to prominence as the cause of damage and justification for funding.

This strategy has enabled restoration to gain broader public and corporate support for the plan, including from oil and gas and transportation. Portraying these major economic enterprises as threatened enterprises, rather than causes of the damage, represented a pivot in the land loss narrative since the 1987 plan and previous congressional testimony. This reorientation displays the more delicate political maneuvering required to build support, but also a diminishment of the voice of the citizen activists. The CRCL, along with a host of other nongovernmental organizations (NGOs) remains very active in promoting restoration. The state has formalized its commitment to addressing the coastal land loss issue by creating the Coastal Restoration Division in 1989, and elevating and consolidating coastal matters within the Coastal Protection and Restoration Authority (CPRA) in 2005. Many restoration supporters continue to point toward canals as a principal cause. Yet, the head of the state coastal restoration agency was critical of a lawsuit filed by a New Orleans area levee district seeking compensation from oil companies for damages resulting from their canals (Houck 2015; Schleifstein, 2014). One thing that has remained constant since the formation of the state agency has been the dedicated focus on science and engineering approaches to the issue. In general, there was widespread political support for the state's current 50-year, $50 billion master plan that includes a mix of ecological restoration and structural protections. Indeed, the state legislature approved it with a unanimous vote. The 2012 master plan's budget places an overwhelming emphasis on science and engineering solutions (CPRA, 2012). The next 5-year update of the master plan is currently under development (CPRA, 2013) and may offer opportunities for expanding social and cultural considerations (CPRA, 2016).

The 2012 plan includes a discussion on cultural heritage, but the depth and thoroughness of the analysis of the potential social and cultural losses is scant when compared with the analysis of land loss. The most recent document casts restoration as a science and engineering enterprise that will provide a mixture of structural (levees, sediment diversions, and hydrologic infrastructure) and nonstructural (floodproofing structures, building codes, and land-use planning) projects. The master plan concedes the nonstructural component of the plan is largely voluntary, whereas other components are not. Of the 116 potential nonstructural projects analyzed by the state, not a single one directly addresses social or cultural restoration or preservation (CPRA, 2012). The orientation of restoration efforts is directed toward ecological and hydrological projects. Although "support of cultural heritage" is one of the decision criteria identified in the plan, no project directly addresses this specific area. At the core of this criterion is the intent to reduce risk for coastal communities and to provide "high levels of traditional natural resources" to residents of the region (CPRA, 2012). The plan includes no discussion of the linkages between society and natural resources. Thus, projects prioritized for funding target ecological, not social and cultural, conditions. Overall, the proposed $50 billion budget allocates about $5 billion for nonstructural work that touches on social and cultural issues.

Elaborate procedures were in place for public input in the development of the plans that exceed opportunities in previous management regimes (CPRA, 2007, 2012; Peyronnin *et al.* 2013; USACE 2004). The Corps of Engineers carried out a series of "phased public participation meeting[s]" leading up to its 2004 report. This effort took place over the course of 2 years and promised continued public involvement (USACE, 2004). In the course of developing its 2007 plan, the state carried out a series of public workshops designed to solicit comments from citizens across the coastal region, decision workshops with science advisors and NGOs, circulated the draft for public review and held public hearings on the draft (CPRA, 2007). Similarly, for the regularly updated plan, the 2012 document included public input through a series of public meetings in the development phase and solicited comments on the draft plan. It reported collecting some 2200 comments on the draft plan, and

some of these led to specific modifications in the plans (CPRA, 2012, appendix G). Indeed, participants in the plan's development claimed its success rested on "stakeholder support," which demanded a comprehensive outreach effort (Peyronnin *et al.,* 2013).

Nonetheless, as the state began moving forward with detailed analysis of specific projects, sediment diversions in particular, local opposition arose (Alexander-Bloch 2015; Boudreaux 2015). Despite support from elected officials, potentially affected communities seemed to be unfamiliar with the plan's specifics. This reaction reflects a NIMBY (not in my back yard) response (Lake 1987), possible inadequacies in public outreach, and the disproportional emphasis on scientific and engineering aspects of the numerous projects. The plan's appendices contained 27 predictive modeling sections as part of the decision-making process—all but three focusing on biophysical processes. None of the science is built on participatory methods that engage knowledgeable citizens in framing research questions, conducting research, and presenting findings (Kasemir, 2003). The lack of balance in the social and cultural dimensions of the coast is another obvious aspect of the plan. The decision support tools contained one section dedicated to cultural heritage (CPRA, 2012, appendices G and I). The overwhelming emphasis in the plan was on the damage to the coast's biophysical ecology and hydrology and its need for restoration, and not the region's society (CPRA, 2012; Peyronnin and Reed, 2013). A group of researchers funded by CPRA and including CPRA staff has offered methods to factor in traditional knowledge and address the social deficit in the decision-making process (Bethel *et al*. 2011). Such projects offer a promising model for citizen engagement that has not been replicated.

In the years after the release of the 2012 plan, the state's coastal restoration agency has moved cautiously to respond to repeated recommendations to facilitate public input and to place social issues on par with environmental analysis. Despite numerous public engagement forums through multiple iterations of planning coastal restoration, a series of expert panel reports delivered to CPRA in 2014–15 called for greater attention to social and economic considerations in planning for sediment diversions, and a CPRA-commissioned report recommended launching a social impact assessment that included public participatory methods before public announcements of diversion projects (Colten and Hemmerling, 2014; WIG, 2014, 2015). Yet, in 2015, the state announced plans to proceed with the Mid-Barataria and Mid-Breton diversions without launching a parallel social impact assessment, even though considerable hydrologic and geologic studies had already been conducted (CPRA, 2015). A community workshop revealed great frustration among residents of St. Bernard and Plaquemines parishes with the lack of consideration by government officials in Baton Rouge to their concerns (Colten, 2014a). Additionally, an activist group of fishermen have launched a campaign to push back against arguably the most high profile project launched to date—the mid-Barataria sediment diversion (Save Louisiana Coalition, 2015; Schleifstein, 2013). Such expressions of discontent reflect what some call a "democratic deficit" that results from the failure of government bodies to incorporate adequate public participation in the early stages of environmental management projects (Vanclay, 2012). Granted there have been opportunities for public involvement, yet the public still expresses frustrations. Responding to concerns about unequal attention to social factors, the state commissioned and released an economic impact report that emphasizes the costs of coastal land loss to oil and gas and transportation industries (Barnes *et al*., 2015), and an atlas on coastal Louisiana's changing social and economic geography is moving toward publication (Hemmerling, 2017). Meanwhile, a Louisiana planning organization secured independent funding to carry out an in-depth assessment of community concerns about "non-structural" components of the master plan to foreground community input (Manning-Broome *et al.,* 2015). Such investigations demonstrate the state is taking steps, and efforts to expand community engagement in the 2017 plan recognize this shortcoming (CPRA, 2016). These products address the historical fidelity of coastal life, but a robust public participatory science has been absent, with the exception of the Bethel *et al*. (2011) study. Elsewhere, science supported by local expertise and experiential knowledge has strengthened restoration planning (Kasemir, 2003).

At the community level, there is great concern about the size and scale of the diversions and the impacts it will have on oyster leases and shrimp populations that first fell under direct state regulation during the emergence of conservation programs a century ago (Colten, 2014a). Through the regulations introduced by conservation policies, the state has fixed oyster gathering in leases and regulated the seasons and waters open to shrimping. These management practices restrict the mobility options open to resource harvesters and thus contribute to the weakening of the adaptive capacity of those pursuing natural resources in the face of another round of environmental change. There has been legislation providing for financial compensation to leaseholders, relocation programs, and a host of state programs to assist oyster gatherers (Stevenson 2000). Additionally, the oyster barrier reef projects in the master plan reflect a commitment to oyster productivity in specific locations, even though diversions might threaten leases in other areas (CPRA 2012).

One adaptive option for coastal residents that is already an on-going process is resettlement. The state master plan includes "voluntary acquisition"—or the purchase of individual properties outside structural protection where elevating homes would be impractical—as one of its options. Resettlement assistance has not received any direct funding from the state, and the current master plan suggests it will be a relatively small part of the budget and that it will be fine-tuned in the future (CPRA, 2012). The topic of resettlement is extremely sensitive among coastal residents and has been avoided in discourse by coastal restoration officials, although not by others (Dalbom, Hemmerling, and Lewis, 2014; Maldonado *et al.,* 2013). Understanding the historical fidelity of this component of human history on the coast is central to addressing future population distributions. Recent developments have addressed this critical issue in a dramatic manner. With a substantial grant from the U.S. Department of Housing and Urban Development, the Louisiana Office of Community Development Disaster Recovery Unit has launched a program designed to

dovetail with the master plan and address the dislocation of people from the coastal zone. Its LASAFE program proclaims to be a people-driven approach to maintaining local culture and society (LOCD 2015a). The state agency, along with the Lowlander Center, an NGO, will work with the Biloxi-Chitimacha Native American community in Isle de Jean Charles to develop a resettlement plan (LOCD 2015b).

Despite local sensitivity to the topic and before this funded project, resettlement was occurring. In part because of changing economic conditions in the global fisheries and oil markets and the restrictions placed on the commons, but also because of the risks of living on a precarious coast, a protracted out-migration of coastal parish residents has been taking place with erratic acceleration after major disruptive tropical weather events. Numerous small towns have been abandoned over the past century after hurricanes. Coastal parishes continue to register extremely low percentages of in-migration from neighboring parishes or other states, but the general trend of population since the mid-20th century has been downward. Additionally, the percentages of elderly residents is high, and the same measure of the very young is low—indicators of long-term population decline. The percentage of people engaged in natural resource–based economic activities has fallen below 5% at the parish level throughout the region, although there are pockets of fisherfolk in Plaquemines and Jefferson parishes. Workers are residing outside the region and commuting longer distances to jobs in coastal parishes, families are shifting inland, and young people drift to urban centers (Data Center, 2014; Manning-Broome *et al.,* 2015; Hemmerling, 2017). Automobility and modern communications, to an extent, stretch the lineaments of kin relationships that once depended on immediate proximity. Baton Rouge and Lake Charles are now no farther away in practical terms than the drive from Leeville to Thibodaux (~100 km, or 60 miles) half a century ago (Figure 1). Despite their celebrated attachment to place, Acadians and Native Americans in coastal parishes are dispersing. Their decisions to depart are another form of adaptation to changing circumstances and part of the historical reality of the region (Data Center 2014; Hemmerling, 2017). Perhaps the LASAFE program will offer a mechanism to engage with the emergent discussion on resettlement more fully and to fold it into planning and budgeting for coastal restoration. Coastal restoration planners have yet to integrate this critical cultural component fully into their analyses.

CONCLUSIONS

The series of wetland management policies, consistently and sometimes in tandem, have impinged on traditional livelihoods by narrowing or restricting access to the commons. Whether taking riverfront property for levees, dedicating floodplain swamps to spillways, draining wetlands for private cultivation by farmers from outside the region, restricting fishing and hunting seasons, setting aside wildlife preserves, or building sediment diversions, wetlands management in Louisiana has restricted access to natural resources that have supported traditional livelihoods. In the course of implementing these policies, the policy makers have largely ignored minorities and traditional fisherfolk in flood control, enabled displacement of natural resource economic activities with wetland reclamation, criticized and restricted the resource-dependent societies with conservation measures, and foregrounded science-driven ecologic concerns over social and cultural issues with restoration. Ultimately, these policies have contributed to uprooting local residents slowly but repeatedly. In a state with one of the highest rates of nativity, the cords to place are being loosened, and this has implications for coastal sustainability.

Despite extensive human-induced environmental damages, along with natural change, local residents have adapted to the arrival of 20th century industries by assisting in exploration of the marshes for oil and gas, by working the irregular shifts required by off-shore platforms, building and piloting crew and supply ships, building the rigs that populate the continental shelf, and working on the waterfronts and watercraft that operate in the region. The deep family roots and attachment to place provided a steady labor pool that incorporated the new economic opportunities into local society.

Even though expanding and deliberate attempts have been made to engage "stakeholders" more fully in the decision making process with coastal restoration, the science-driven approaches of the different environmental management schemes have not sought to incorporate what Higgs (2010) calls the historical fidelity of the region or to rely on robust public participatory science methods. Recent successful examples of participatory science offer a path toward a more socially engaged and culturally sensitive approach to restoration. Whereas the science of coastal land loss is founded on historical analysis of the changing shoreline, no comparable detailed and on-going analysis of human activity has been launched in alignment with the biophysical analyses. There have been extensive modeling and studies of ecological, hydrological, and geological components of the coastal region, and to a lesser extent demographic and economic patterns for selected industries, but there has been no comparable accounting of the social capital of coastal residents, no comparable evaluation of local culture and attachment to place, and no comprehensive discussion about the methods and procedures to advance restoration of society and culture after the disruptions that will accompany ecological restoration. A full-fledge consideration of social and cultural capital, with or without the master plan, that is comparable to the science of land loss and restoration is an opportunity for improvement in the next iteration of the state's important master plan.

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