HUMAN IMPACTS ON COASTAL AND ESTUARINE ENVIRONMENTS IN MISSISSIPPI

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ABSTRACT

Although Mississippi's toehold on the Gulf of Mexico extends less than 110 km from border to border as the crow flies, human modification of the coastal zone has been extensive. Two of the three major subcomponents of the state's terrestrial coastal environment—the mainland shoreline, the estuarine embayments, and the barrier islands—have been substantially modified by human activity. Almost half of the 130 km long mainland shoreline has been altered by seawall construction and artificial beach nourishment. The wetland-fringed estuarine embayments of St. Louis Bay and Back Bay of Biloxi became popular loci of recreational development in the boom years of the 1950s and 1960s, and dredge-and-fill activity was widespread. Likewise, industrial development proceeded rapidly during that period, and not until passage of the Mississippi Wetlands Protection Law of 1973 did wetland modification become significantly reduced. Only the barrier islands have escaped extensive human alteration, although development plans have been (and still are) proposed from time to time. The erosion and destruction of the casino resort of Isle of Caprice (presently the Dog Keys shoals) in the 1930s effectively halted offshore resort development plans for several decades, and today three of Mississippi's four barrier islands are included in the Gulf Islands National Seashore.

INTRODUCTION

The Mississippi Gulf Coast may be described as one of the most engineered shorelines of the United States (Canis et al., 1985). Most of Hancock and Harrison Counties are
fronted by a combination seawall/artificial beach, and two reaches of Jackson County (Ocean Springs and Pascagoula) have been similarly modified (Fig. 1). The remaining shoreline reaches of the mainland are subject to storm-induced erosion (averages vary from 2 to 3 m/yr), and vacation home owners in Jackson County are presently petitioning the state to do something to retard loss of their beachfront properties. Mississippi's coastal wetlands, in close proximity to the major historic urban areas, were greatly affected by dredge-and-fill activity in the 1950s and 1960s for both recreational and industrial development. Based upon a research methodology that is mostly archival, this paper represents a preliminary effort in describing the impacts of humans as geomorphic agents in the Mississippi coastal zone—especially along the mainland beaches.

GEOLOGIC SETTING

The geomorphic features that formed during previous high stands of sea level strongly influence the present-day distribution of beaches, wetlands, and islands of the Mississippi coast (Meyer-Arendt and Gazzier, 1990). Narrow eroding beaches formerly fronted the Pleistocene barrier complex of Harrison County as well as Pleistocene headlands in Hancock and Jackson Counties (Otvos, 1985). Tidal wetlands are found in and near the bayhead deltas of modern drainage systems. These areas include the Pascagoula River delta and protected low energy bays and deltas of Back Bay of Biloxi and St. Louis Bay (Meyer-Arendt, 1989). Delta progradation and aggradation are still active in the sheltered bays, but the Pascagoula bayhead delta has prograded into Mississippi Sound to a point where erosion and deposition are nearly balanced. In addition to bayhead delta marshes, extensive marshes formed in southern Hancock County as a result of the Mississippi River St. Bernard delta deposition and in eastern Jackson County marshes as a result of Pascagoula River fluvo-deltaic sedimentation into what is now known as the Bayou Cumbest delta complex (Gazzier, 1977; Kramer, 1990; Meyer-Arendt and Kramer, 1991). The barrier islands—Petit Bois, Horn, Ship, and Cat Islands—formed via a combination of shoal emergence and modification of existing Pleistocene-Holocene beach-barrier complexes and are highly dynamic—i.e., transgressive as well as westward-migrating (Kwon, 1969; Waller and Malbrough, 1976; Shabica et al., 1984; Otvos, 1979; Rucker and Snowden, 1990).

SETTLEMENT AND IMPACTS ON THE MAINLAND COAST

Since arrival of the French in 1699, the mainland Mississippi Gulf Coast has been a popular locus for settlement. Sheltered from high wave energy by the barrier islands and a shallow Mississippi Sound, the mainland coast was perceived to be somewhat more protected from devastating hurricanes. Throughout the 18th century, the coastal inhabitants were mostly engaged in fishing, farming, stock-raising, exploiting pine resources, and trading with the urban center of New Orleans (Alexander, 1980; Scholtes and Scholtes, 1985; Sullivan et al., 1985). Periodic incursion by marauding Indians drove the settlers to the barrier islands (especially Cat Island), and periodic hurricanes drove the surviving settlers back to the mainland (initially Biloxi and Deer Island) (Sullivan et al., 1985). The population was relatively low (a census in 1811 listed a total of 770 inhabitants in coastal Mississippi), and human impacts remained relatively insignificant (Sullivan et al., 1985).

The 19th century witnessed increasing urbanization along the mainland coast, primarily as a direct result of coastal tourism and recreation. Even before admission into the United States in 1811, New Orleans sojourners made their way to the narrow natural beaches of Hancock County (Clai borne, 1876). With the advent of the steam engine and the introduction of steamboat service between New Orleans and Mobile in the early 1830s, increasing amounts of trade and tourism were noted in Mississippi (Hayden, 1950). The ante bellum period of the 1840s and 1850s was characterized by increased visitation (by New Orleanians fleeing summertime yellow fever outbreaks and by Mississippi plantation owners and their families) and increased hotel and summer home construction (Smedes, 1965). In the 1840s, a new city—named Mississippi City—was platted and it became the seat of the newly created Harrison County. Pass Christian, with its New Orleans connection, became a resort “equal to White Sulphur Springs, Saratoga, and Newport” and boasted of the oldest yacht club in the South (Hayden, 1950). Because of a virtual absence of a sand beach, however, it has been suggested that it was not the attraction of the environment that led to tourist development but rather the annual summertime evacuation of disease-prone New Orleans (Hayden, 1950; Sullivan et al., 1985). The shell-strewn muddy flats of Pascagoula attracted wealthy summer refugees from Mobile. Biloxi, historically the largest city as well as the most important commercial center on the coast, received tourists from both New Orleans and Mobile, and several hotels were built (including the Magnolia Hotel—renovated and still standing). The Biloxi waterfront was characterized by numerous wharfs where the steamships and sailing vessels docked (Fig. 2).

The Civil War interrupted this incipient tourism boom, but postwar developments such as opening of a railroad line between New Orleans and Mobile in 1870 stimulated a new tourism boom. At the same time, Biloxi became the center of a new seafood-canning industry, and previously underutilized resources such as shrimp and oysters became valuable commodities. A link with the interior of Mississippi became realized with the southward expansion of rail lines
from Hattiesburg in the 1880s (Black 1986). By the 1890s, a new port—incorporated as Gulfport in 1898—was created, a channel was dredged to Ship Island. The former Ship Island anchorage became obsolete, as ships could now dock directly at the end of the rail line (Black, 1986).

All of these events led to a greater coastal population and an increasingly complex coastal infrastructure. Prior to the 1870s, there was no formal "road" along the beach. The historic connection from east to west was along the Pass Christian-Port Cadet Road (Pass Road) which ran along the spine of the Pleistocene barrier. The 1870 Louisville & Nashville Railroad was built a short distance closer to the Sound. The beach became popular for strolling and buggy riding in the 1870s, although the latter often became mired in wet sand (Lang, 1936). However, the booming oyster industry produced a valuable byproduct—shells—which were first used for land reclamation of the Biloxi waterfront. These shells, crushed, also served as a suitable roadbed material and the discontinuous beach road took on the name of 'old shell road' (Black, 1986; Sullivan et al., 1985). In spite of a serious hurricane in 1893, the segments of the Shell Road gradually became extended. Soon the beachfront contained telegraph poles and boardwalks, and although a 1901 hurricane caused extensive damage to the beachfront, plans for building a trolley line were not even interrupted (Sullivan, 1985; Sullivan et al., 1985) (Fig. 3).

The impacts of subsequent hurricanes were greater. When a 1909 hurricane caused serious damage to the shell highway and new interurban trolley, petitioning for state involvement in erosion control began. A more severe hurricane in 1915 destroyed 50% of the beach roadway (by now nearly continuous along Harrison County), and the following year the Mississippi legislature passed a law committed to highway protection (anon., 1930). Partly to ensure that a state commitment would be made, the Harrison County communities linked and improved the old Shell Road (in 1918 rechristened the Old Spanish Trail as part of a national tourism promotion effort). Rights-of-way were obtained, low areas were filled, and the road was graded and partially paved—a vast improvement over the oyster shells, according to Model T drivers (Bergeron, 1991).

The 1915 storm directly stimulated seawall construction along the Mississippi coast. Hancock County built its seawall on a piecemeal basis between 1915 and 1928 (Sand Beach Planning Team, 1986) and seawalls were built at Ocean Springs and Pascagoula in the late 1920s (Higginbotham, 1967). The greatest feat of all was the construction of the 42 km seawall fronting Harrison County, supposedly the second longest seawall in the world (Davis, 1988; Mississippi Department of Wildlife Conservation, 1986) (Fig. 4). Although the seawall (funded by a state tax on gasoline) proved to effectively protect the highway and coastal property in the absence of several storms, the narrow natural beach quickly disappeared. By the early 1940s, several of the beach hotels—mostly built during the 1920s tourism boom (Prior, 1947)—had created their own sand beaches by pumping sand between groins.

Mississippi was entering a postwar rejuvenation in tourism when a severe hurricane made landfall in 1947. The seawalls of Harrison and Hancock Counties were greatly damaged, and artificial nourishment was recommended to protect the seawall and highway in Harrison County (Wilson, 1951). By the early 1950s, 285 hectares of beach nourishment, or up to a 90 m wide beach over a 40 km stretch of Harrison County, were created in 1951 (Escoffier, 1956; Escoffier and Dolive 1954; MacArthur, 1956; Walton and...
Purpura, 1977; Watts 1958) (Fig. 5). The county thus boasts of “the longest man-made beach in the world” (anon., 1951).

In spite of this stabilization, storms frequently removed much of the beach and periodic placement of new fill was necessary. Hurricane Betsy in 1965 caused much damage to the as yet unprotected seawall in Hancock County, where a 10 km long artificial beach was constructed by 1969 (Dixon and Pilkey, 1991; Sand Beach Planning Team, 1986). Hurricane Camille in 1969 was perhaps the worst hurricane to ever strike the U.S. coast, and in addition to extensive
destruction and loss of lives, the Harrison County sand beach was greatly eroded (although the seawall withstood the storm relatively well (Sullivan, 1985). A major post-storm beach renourishment project was completed in the early 1970s (Dixon and Pilkey, 1991). Hurricanes in 1985—especially Elena—caused more sand removal, especially in Hancock County which was not renourished following Camille. The county has presently (1991) applied for a permit for a beach renourishment project (Fig. 6). Periodic nourishment also has been necessary to maintain the sand beach fronting Ocean Springs. In Harrison County, recent experiments with grass planting and emplacement of feeder dunes may—optimistically—cut down on the volume of fill that is needed for maintenance nourishment.

The mainland shoreline of Mississippi has been greatly modified since the first settlers arrived. The seawall/artificial beach complex, which has held up relatively well under normal wave conditions, has—in Harrison County—extended the shoreline further seaward than it was even 100 years ago. In Hancock County, the seawall stands at the approximate position of the 1918 shoreline (Sand Beach Planning Team, 1986). Only in the Bellefontaine/Gautier Pleistocene headland complex have homes been built along an erosive shoreline. Although several groins have been built to conserve the limited amount of sand, erosion continues and several landowners are requesting state assistance in shore protection.
HUMAN MODIFICATION OF WETLANDS

Until the 1940s, Mississippi’s coastal wetlands remained relatively unaffected by human activity. This began to change in the 1950s and 1960s as a national craze for residential canal waterfront lots made inroads into Mississippi. Developers would select what was previously considered undesirable lands—low-elevation pine flats and marshlands—and convert them into residential subdivisions (Fig. 7). Between 1956 and 1973, the wetland area of Mississippi was reduced by over 2,000 ha—from over 28,000 ha to less than 26,000 ha (Meyer-Arendt, 1989). Half of this loss was within marshes fringing the estuarine embayments of St. Louis Bay and Back Bay of Biloxi (Meyer-Arendt, 1989). In addition to loss to residential subdivisions, wetlands succumbed to industrial development, dredging for roadbed fill, and deposition of spoil material. Passage of the Mississippi Wetlands Protection Law in 1973 has fairly effectively halted the previously high rates of wetland conversion, however (Meyer-Arendt, 1989).

HUMAN MODIFICATION OF BARRIER ISLANDS

Human alteration of Mississippi’s barrier islands has been minor in comparison with the mainland shoreline or the mainland wetlands. Historically, the islands were seen as refuges from hostile Indians, and Cat Island and Deer Island had small pockets of inhabitants. Commercially, Ship Island became most important (especially during the 19th century) because of its natural ship anchorage. Fort Massachusetts was built in the 1850s and a quarantine station was constructed nearby after the 1893 hurricane destroyed the one on Chandeleur Island in Louisiana (Sullivan et al., 1985). Lighthouses were built on the islands, including Horn Island, Cat Island, and Round Island, but early 20th century hurricanes (1901, 1909, 1915, 1916) eventually removed most of these structures. Cattle-grazing was common on the barrier islands well into the 1950s, and during the war, the U.S. military conducted mustard gas experiments on Horn Island. The most significant geomorphic modifications of the islands included a mid-1970s beach nourishment project to protect a severely eroding Fort Massachusetts and loss of westward-drifting longshore sediments to navigation channels at the west ends of Petit Bois and Ship Island.

Tourism development has also affected Mississippi’s islands, but lasting human impacts have been minor. Deer Island, an transgressive Holocene-emergent barrier island flanking the entrance to Biloxi Bay, was briefly developed as the “Coney Island of the South” prior to landfall of the 1915 hurricane (Meyer-Arendt and Gazzier, 1990). During the 1950s boom, elaborate plans for enlarging the island

Figure 7. Residential canal subdivision at Jourdan River and Bayou La Croix confluence, 1988 (photo by author).
threefold by dredge-and-fill activity were proposed (Rader and Associates, 1958), but these plans never materialized. Subsequent similar development schemes were bitterly opposed by local environmental groups (Rhode and Hall, 1982; Rhode, 1983) although retreat rates have not been as high as on other barrier islands or even mainland shores. Deer Island is subject to frequent storm erosion (Hurricane Elena breached the island in 1985). In one of the first efforts to develop islands directly fronting the Gulf of Mexico, local entrepreneurs selected the shifting Dog Island for resort construction in the 1920s (Powell, 1988; Rucker and Snowden, 1988). Renamed the Isle of Caprice, the island casino and hotel did a booming business during the Roaring 20s, but shifting shoals led to the gradual crumbling of the resort by 1932 (Rucker and Snowden, 1988). The erosion and destruction of the casino resort of Isle of Caprice (presently the Dog Keys shoals) effectively halted offshore resort development plans for several decades. In the late 1960s and early 1970s, plans for the development of Horn Island surfaced at about the time the National Seashore program was acquiring coastal properties. Except for Cat Island which has the longest history of private ownership, Mississippi’s barrier islands are now included in the Gulf Islands National Seashore. Development plans for Cat Island surface from time to time, and even in the late 1980s a causeway to the island was proposed!

SUMMARY

The extent of human impacts in the Mississippi coastal zone has been great. Most of the shore fronting Mississippi Sound has been altered by seawall/artificial beach construction, especially in Harrison and Hancock Counties. Many of the wetlands witnessed extensive dredge-and-fill activity during the boom years of the 1950s and 1960s, when over 2000 ha of marshland were converted to open water or functional uplands. Only the barrier islands have been spared extensive alteration, although numerous plans for recreational urbanization have been proposed.

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