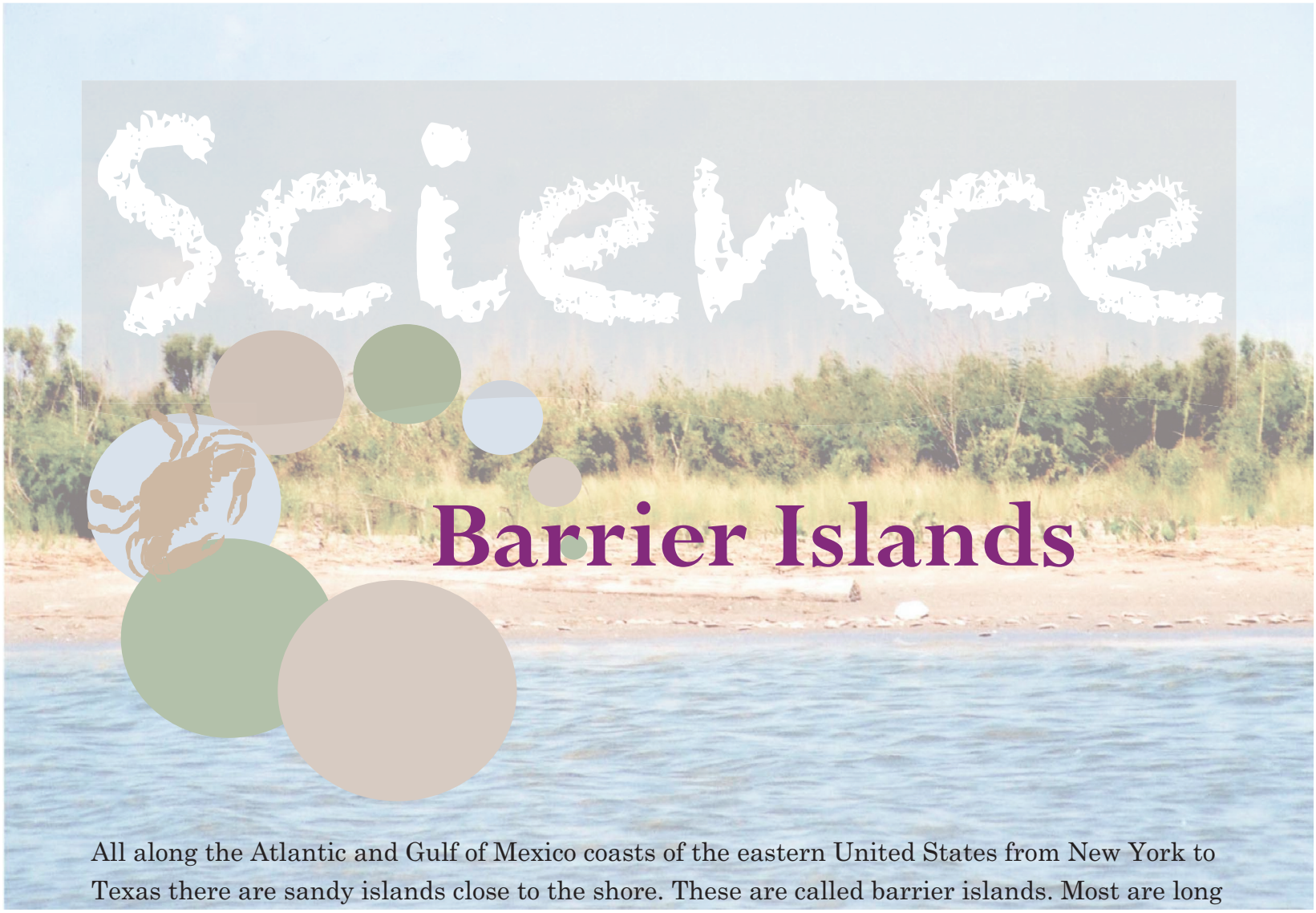


Barrier Islands

All along the Atlantic and Gulf of Mexico coasts of the eastern United States from New York to Texas there are sandy islands close to the shore. These are called barrier islands. Most are long and thin, oriented parallel to the shoreline. These islands have many things in common but also have many different characteristics. They all consist of a sandy beach facing the ocean or Gulf with several other habitat zones including dunes, swales, maritime forests, marshes and tidal flats. The specific natural environments vary from island to island. The bays, estuaries and lagoons found behind the islands are typically rich in marine life. The islands serve to protect these ecologically valuable places.

These small land masses also protect human communities on the mainland from the destructive energy of tropical storms and hurricanes. Despite their protective function, barrier islands are very dynamic and always on the move. Their formation depends upon the movement of sand by waves, tides and currents, and these forces continue to act on all barrier islands. Many barrier islands are popular vacation sites. Resort towns have been developed on many of these islands. However, attempts to prevent erosional forces from threatening human-built structures are usually ineffective.

Scofield Beach (photo credit: Marian Martinez)

Louisiana Barrier Islands

Scofield Beach arial view (photo credit: Marian Martinez)

The islands of the Louisiana coast were all created as a by-product of the Mississippi River Delta. Most are features associated with an older delta lobe that is no longer growing, and sea level rise is causing a "transgression" or an inland migration of the shoreline. Louisiana barrier islands tend to be low-lying and very vulnerable to inundation during storms. Currently, Grand Isle is the only barrier island on our coast on which there is a permanent settlement. Other settlements have been abandoned in very recent history as erosion has claimed more and more of the island area.

The Importance of Barrier Islands

Protection from Storms

Barrier islands take the brunt of impact from an incoming storm, thereby protecting the habitats and structures behind them. This makes barrier islands important in times of hurricanes and tropical storms. For example, the Timbalier Islands and the Isles Dernieres chain offer protection for communities in Terrebonne and Lafourche parishes.

Wildlife Habitat

Barrier islands contain a variety of habitat zones, all of which are valuable to wildlife. They provide a nesting habitat for birds such as brown pelicans, skimmers, and several species of terns and gulls. They also offer the first landfall for migrant neo-tropical birds arriving on the North American mainland after crossing the Gulf of Mexico in the spring. Here the birds refuel before continuing their journeys north. Monarch butterflies feed on the flowering plants of the barrier islands before and after crossing the Gulf of Mexico in the fall and spring. The shallow protected bays and estuaries behind the barrier islands are one of the richest aquatic environments on the planet, providing food resources for humans such as oysters, crabs, shrimp and fish.

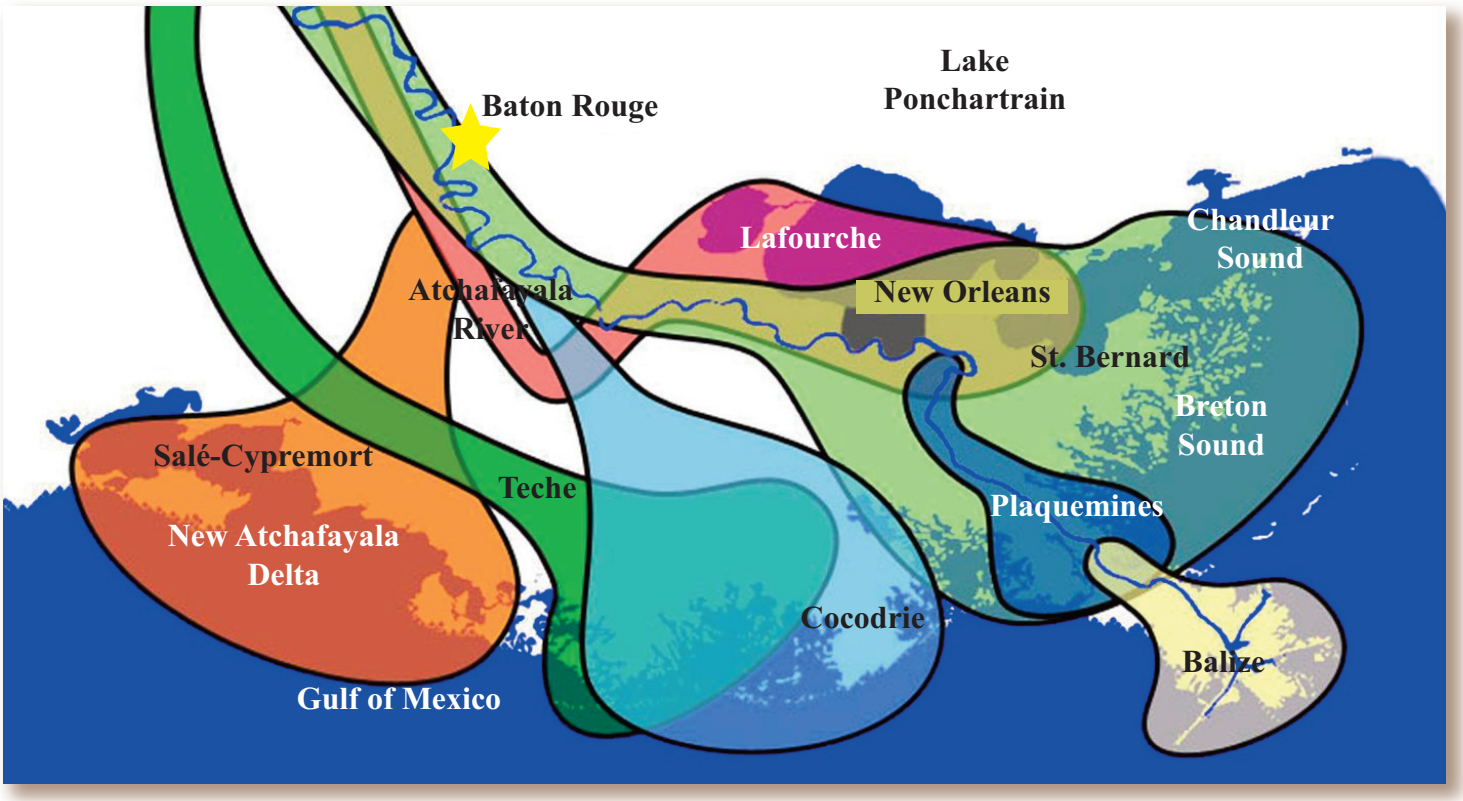
(photo credit: Marian Martinez)

The Formation and Evolution of the Louisiana Barrier Islands

There are several theories for barrier island development. All of the barrier islands on the Louisiana coast are the product of the receding Mississippi River Delta lobes, which formed over a period of about 7,000 years as the river deposited sediment over three million acres, an area known as the delta plain. The delta plain is made up of a number of overlapping delta lobes. Each lobe was deposited over the course of about 1,000 years. Approximately once every millennium the lower part of the Mississippi River changed its path to the Gulf of Mexico, finding a more efficient way. Each new route leads to the development of a new delta lobe. This process is known as delta switching or the delta cycle. This is a natural process that many river deltas go through.

The seven major delta lobes of the Mississippi River

The diagram below shows the seven lobes in order of age from oldest to youngest.

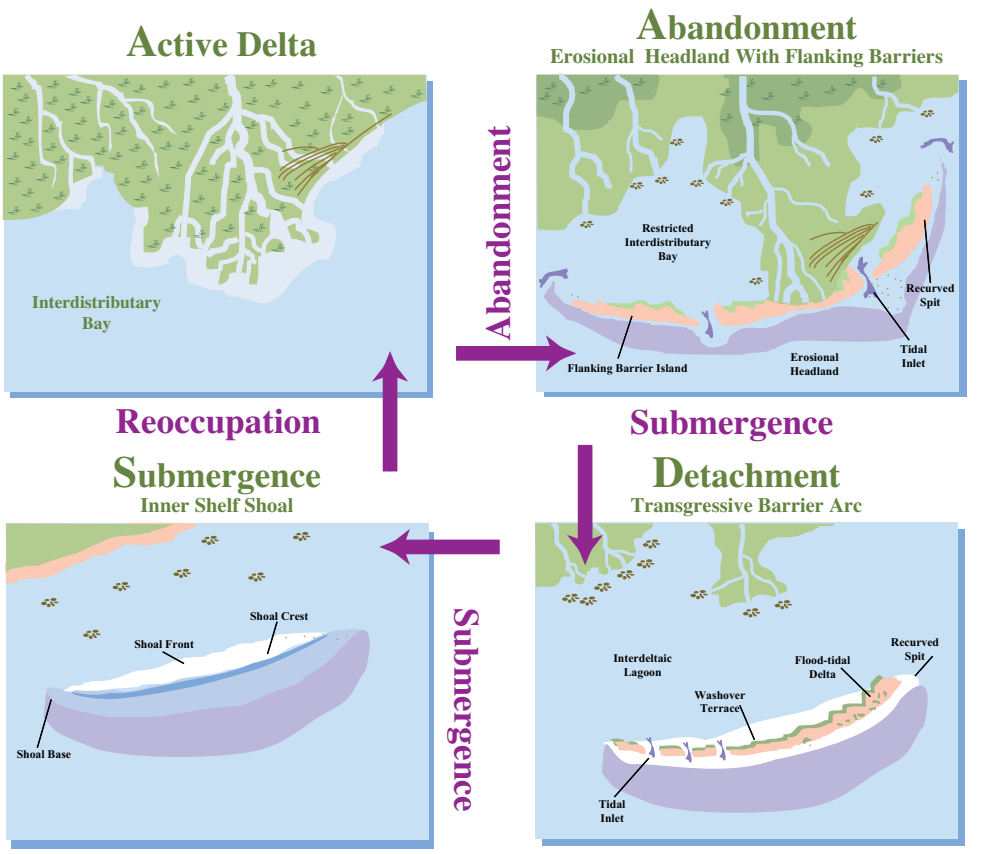


Kolb,van Lopik (1958). Geology of the Mississippi River deltaic plain, southeastern Louisiana. Technical Report 3-483. Vicksburg, MS: U.S. Army Corps of Engineers Waterways Experiment Station
Kulp, M. A., Howell, P., Adiau, S., Penland, S., Kindinger, J., and Williams, S. J., 2002, Latest Quaternery stratigraphic framework of the Mississippi delta region: Gulf Coast Association of Geological Societies Transactions, v. 52, p. 573-582.

Salé-Cypremort	4600 years BP	Lafourche	1000-3000 years BP
Cocodrie	4600-3500 years BP	Plaquemines	750-500 years BP
Teche	3500-2800 years BP	Balize	550 years BP
St. Bernard	2800-1000 years BP		

Barrier island development in Louisiana is tied in to this process of delta building. As the river abandons a delta lobe, it begins a slow decline because it is no longer receiving a supply of new sediment and fresh water. A new delta lobe begins to grow where the river is actively depositing new sediment. The old lobe continues to erode as the forces of waves, winds, and currents rework the sediment. Eventually, subsidence and sea level rise cause the submergence of the land. The reworked sediment forms a headland that continues to evolve with the development of flanking barriers. Eventually, these features become separated from the headland and continue to migrate and change. Finally, erosion and relative sea level changes cause the island to be completely submerged, resulting in a shoal beneath the water.

Barrier Island Evolution



Barrier Island Formation Model - Penland et al.
From *Barrier Island Erosion Study: Atlas of Shoreline Changes in Louisiana from 1853 to 1989, US Geological Survey, Miscellaneous Investigation Series 1-2150-A*

The five steps of barrier island formation:

Active Delta: The delta is actively bulding land, depositing sediment from the channel into the Gulf of Mexico.

Abandonment: The delta is no longer active and erosional forces are at work on the headland, forming sandy spits on either side of the old channel.

Detachment: The combined effects of sealevel rise and subsidence (relative sea level rise) cause the barrier to detach from the mainland and become an island.

Submergence: Relative sea level rise continues to submerge the barrier island. Eventually it becomes a shoal beneath the water.

Reoccupation: Given completely natural conditions (which do not exist today) the Mississippi River's distributaries could eventually reoccupy the area and begin building a new delta lobe and the cycle would continue.

The Status of Louisiana's Barrier Islands Today

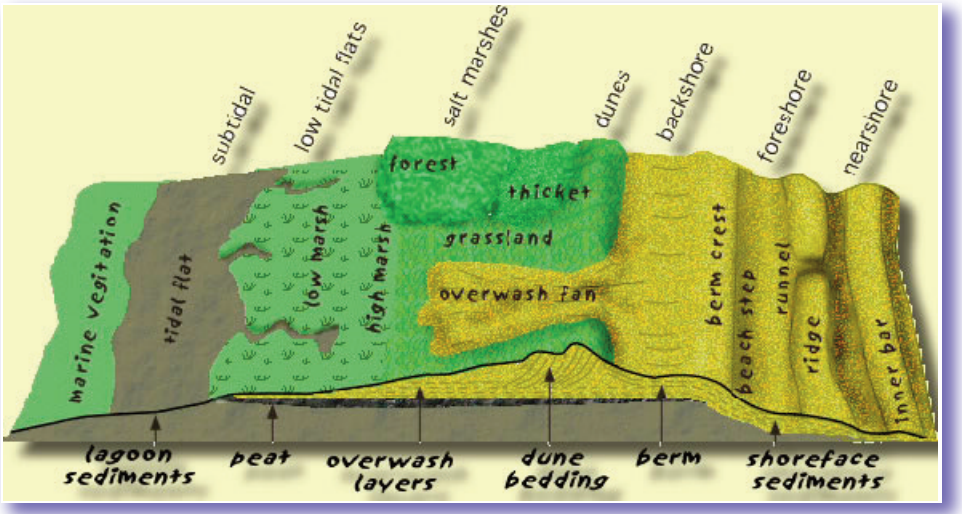
The barrier islands of Louisiana are vital for the protection of Louisiana's coastal communities and its natural resources. They are the first line of defense from summer's hurricanes and winter's storms. However, barrier islands are no longer building naturally. The previously-illustrated cycle has been interrupted by "reoccupation" to the natural processes that drive it. For "reoccupation", stage five of the barrier island termination model, to occur, completely natural conditions that allow the river to rebuild its delta are required. These conditions do not exist because people have altered the course of the Mississippi River in order to control it from flooding and for navigational purposes.

After the great river flood of 1927, the public requested that the U.S. Army Corps of Engineers construct large levees and install control structures in places where the river was likely to change course. One such place is where the Atchafalaya River branches off from the Mississippi River. An example of this is near Simmesport, where the "Old River Control" Structure prevents the flow of water from the Mississippi River into the Atchafalaya River from exceeding 30% of the total volume. If it were not for this structure, the majority of flow of the Mississippi would switch to the course of the Atchafalaya River. A new delta lobe would develop at the mouth of the Atchafalaya south of Morgan City, LA. Currently, with only 30% of the flow entering the Atchafalaya, a small delta lobe is forming in Atchafalaya Bay. As long as the Old River Control Structure holds the Mississippi on its present course, the complete switch cannot take place. The current "Modern" delta lobe would be abandoned and barrier island formation would begin in the location that today is the mouth of the Mississippi River. Because the river is being controlled by humans, the "Modern" delta continues to grow out into the Gulf of Mexico. It is now close to the edge of the continental shelf, the area of shallow water nearest to the coast. The sediment that exits the mouth of the river is deposited in the deep water of the Gulf and is lost from the estuary as a land building material. This material could build new barrier islands or marshes if it could be captured. Instead, the existing barrier islands continue their natural deterioration and no new islands or land can form. The only way to solve the problem without allowing the Mississippi River to change course, is to pump sediment from the floor of the Gulf of Mexico continental shelf onto the existing islands. This method of barrier island restoration has been used successfully in recent years.

The Anatomy of a Louisiana Barrier Island

Below is a cross section of a "typical" barrier island. Barrier islands vary greatly, but a typical island off the coast of Louisiana would have the following features: Beginning at the shoreline of the Gulf of Mexico, the beach rises gently in elevation. The sand is fine-grained and tan in color. Shells and "beach rock" as well as many kinds of natural and man-made debris are scattered through the sand. In some places muddy clay may be exposed and areas of old marsh grass roots embedded in the mud will be visible.

Moving away from the shore, small dunes appear. Vegetation grows on the dunes, holding the sand in place and also trapping new sand and helping the dunes to grow in size. The plants are adapted to this unstable environment, with specialized root systems and coarse leaves that can withstand salt spray and constant wind. Higher on the dunes, small, highly specialized shrubs thrive. Behind the dunes there may be areas of mud flats, which are inundated when a storm surge washes over the dunes. Sand from the dunes may be pushed in "washover fans" onto the mud flats. Here animals such as fiddler crabs may be found burrowing into the mud.

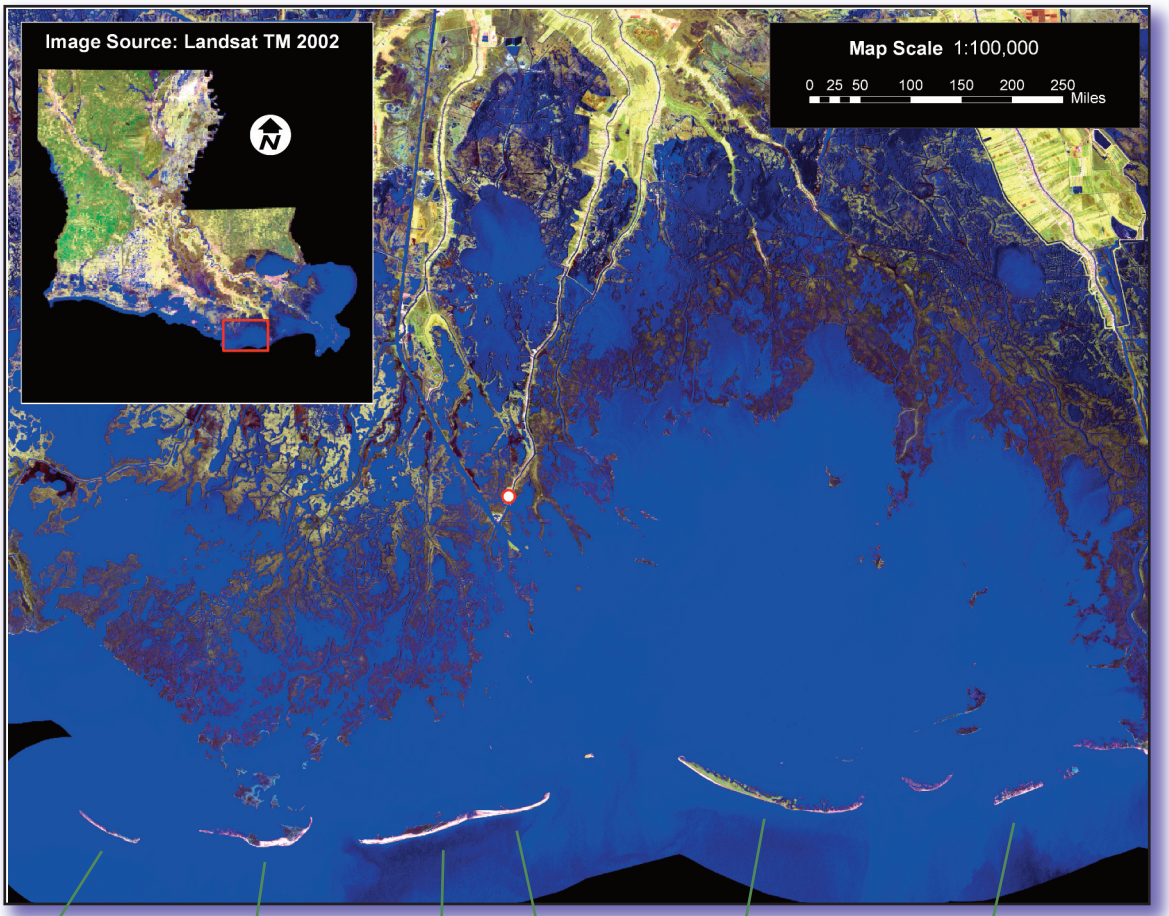


Cross section of a generalized barrier island. Not all features are present on all islands. Louisiana's islands tend to have a much lower profile than those to the east along the Atlantic coast. The dunes are small and trees may not be present on the island. Godfrey, P. J., 1976, Barrier beaches of the east coast: Oceanus, v. 19, n. 5, p. 27-40. http://w3.salemstate.edu/~lhanson/gls214/gls214_barrier_isl.htm

Behind the mud flats are areas of salt marsh. This marsh is important for many species of marine life. The most common grass is **Oyster Grass**. **Black Mangrove** trees may grow on the edge of the marsh. Louisiana barrier islands generally lack trees, but Grand Isle is the exception. Its higher elevation allows maritime oak forests to survive and provide habitat for a variety of organisms. Behind the marsh the shallow water of the bay is often occupied by **submersed aquatic vegetation**. The island protects the bay from the wave energy of the Gulf, and the bay serves as an important nursery for the seafood species for which coastal Louisiana is renowned.

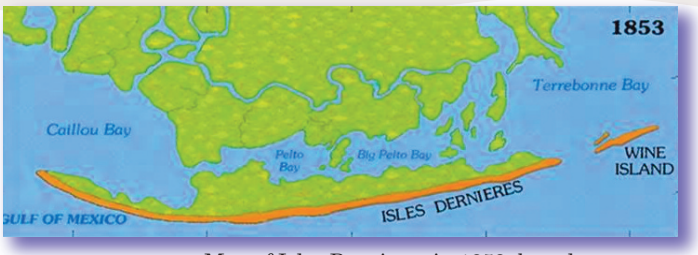
Barrier Islands of Barataria Terrebonne

Two "chains" of small barrier islands are featured on the posters: *The Isles Dernieres (Last Islands)* and the *Timbalier Islands* (The Barrier Island Poster Series is available at BTNEP). At one time, the small islands that make up the two chains were joined to make two larger, continual islands. Erosion has taken its toll, leaving only fragments of the islands that existed in the 1800's. Both island chains are remnants of the Lafourche delta lobe of the Mississippi River delta, but were created by sediment deposited by two different branches or distributary channels of the Mississippi River. The Timbalier Islands were formed after the abandonment of Bayou Lafourche by the Mississippi River. Reworked sediment at the mouth of Bayou Lafourche formed both Grande Isle and the Timbalier Islands. The Isles Dernieres are a result of the sediment at the mouth of Bayou Petit Caillou being reworked by tides and currents.

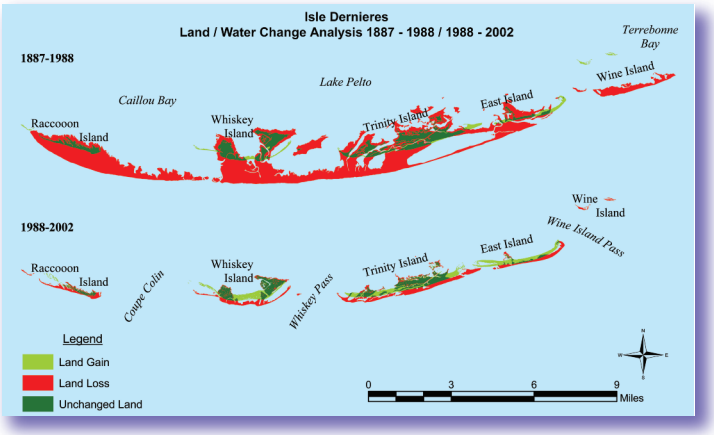


The Isles Dernieres

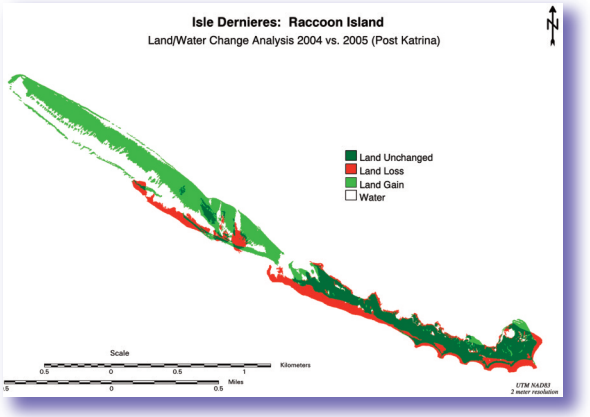
The Isles Dernieres are today made up of either three, four or five islands, depending on your perspective! The complete set of five from west to east are: Raccoon, Whiskey, Trinity, East and Wine Islands. Wine Island was restored with rocks and dredged material after it became a shoal. Today, there is little remaining of the original island. As a result of Hurricanes Katrina and Rita, Trinity and East Islands joined together, after sediment accumulated in the tidal inlet between them. This recent change underscores the dynamic nature of the barrier islands. In the 1850's, Isles Dernieres was a single island barely detached from the mainland. In those days people farmed, grazed cattle and lived and vacationed on the island.There was an overland route used to drive cattle to and from the island. In 1856, a catastrophic hurricane caused a storm surge to wash over the island and to destroy a resort village on what is now Raccoon Island. About 140 people were killed and the village was abandoned. No permanent structures exist on the islands today and a visit to any part of Isles Dernieres requires a seaworthy boat.



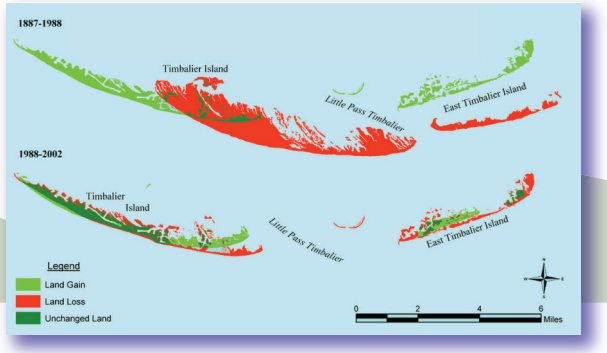
Map of Isles Dernieres in 1853, based on surveys made at that time. Source: *Louisiana Barrier Island Erosion Study: Atlas of Shoreline Changes*



Shoreline change analysis maps of Isles Dernieres. Top: change between 1887 and 1988. Bottom: change between 1988 and 2002. Map Courtesy of UNO Pontchartrain Institute for Environmental Sciences.

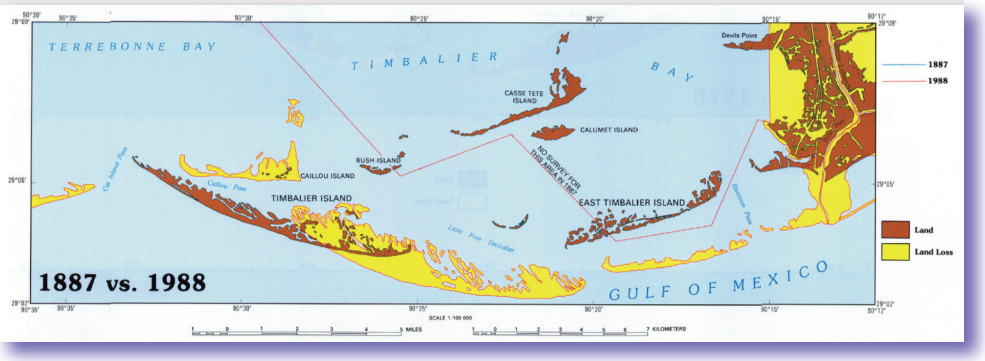


Raccoon Island 2005-2006. Map Courtesy of UNO Pontchartrain Institute for Environmental Sciences.



Shoreline change in the Timbalier Islands 1887—1988. Map Courtesy of UNO Pontchartrain Institute for Environmental Sciences.

Timbalier Islands



Today, the Timbalier Islands are made up of two distinct islands, East Timbalier and West Timbalier (often referred to just as Timbalier Island). Erosion due to subsidence, lack of sediment, sea level rise, waves, and winds from many storms has reduced the land area of the islands dramatically, while the natural migration has moved the islands towards the mainland. In addition, oil and gas exploration and production has been particularly active at East Timbalier Island. Canals and disturbance of the land for drilling have added to the loss that is taking place in this area.

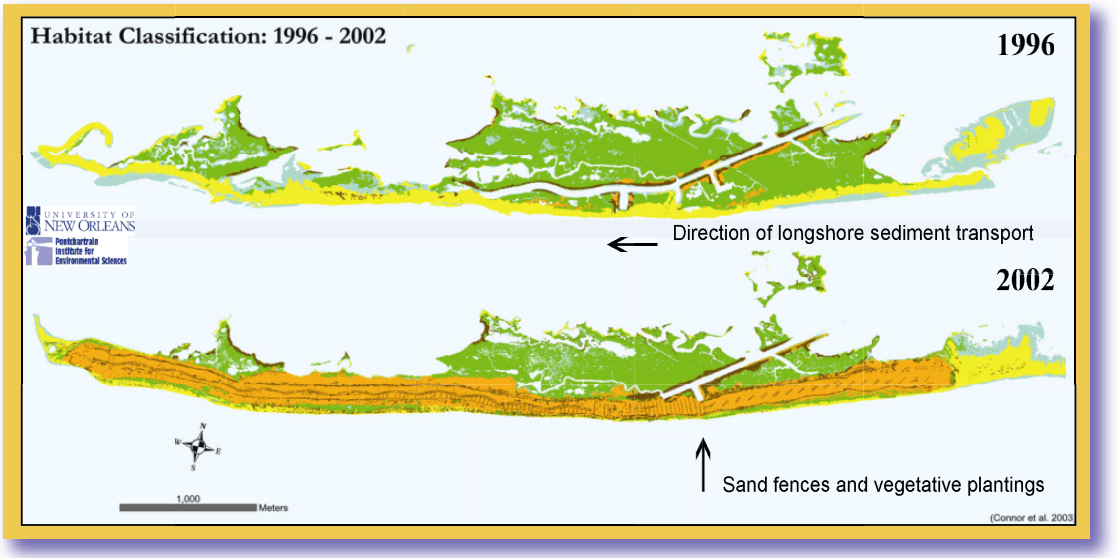
Grand Isle

Grand Isle is Louisiana's only inhabited island. Unlike all the others, it continues to support a viable community—the thriving, though vulnerable Town of Grand Isle. It also supports oil and gas infrastructure, recreational and commercial fisheries, marinas and the Grand Isle State Park. Cultural events such as the annual Grand Isle Tarpon Rodeo and the Grand Isle Bird Festival attract many visitors. Grand Isle is a flanking barrier of the headland created by the eroding Lafourche Delta lobe. Grand Isle is detached from the mainland at Caminada Pass, but Louisiana Highway 1 crosses the pass via a bridge. It is a larger and more geologically stable island than many of the neighboring islands. It supports maritime live oak forests in addition to sandy beaches, dunes, mud flats and salt marshes. A visit to Grand Isle requires no boat and is a great way to learn about barrier island habitats and geology, as well as the varied methods of shoreline erosion control.

Grand Terre Island

Courtesy of the U.S. Geological Survey

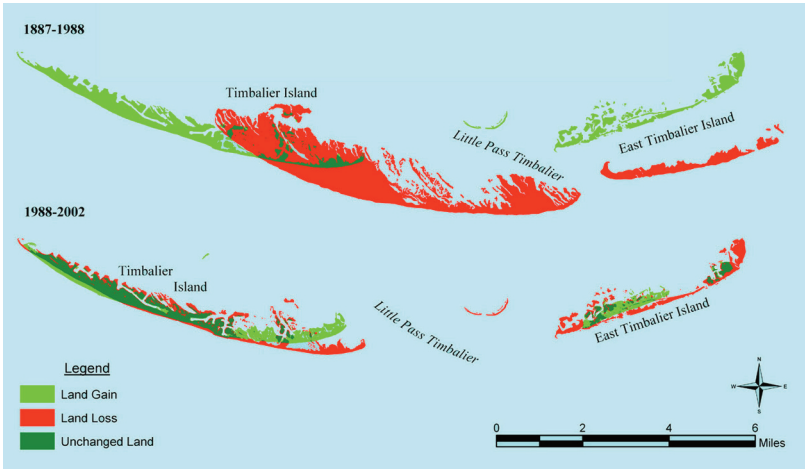
Grand Terre Island is Grand Isle's eastern neighbor. It sits across Barataria Pass from the eastern end of Grand Isle. Geologically, the two islands have different origins and Grand Terre is further along in the "submergence" stage of the "Barrier Island Formation Model." Grand Terre has suffered a great deal of land loss and erosion in recent years. A visit to Grand Terre requires the permission of the Louisiana Department of Wildlife and Fisheries (LDWF), owners of the property. On the western end of Grand Terre the LDWF once operated a Marine Research Lab there for many years. This lab has been relocated on Grand Isle. Fort Livingston, also located on the western end, is part of the Louisiana State Parks system and is protected. At one time, sugar was grown at the Forstall Plantation and processed at a sugar house on the island. Shoreline erosion has claimed all but a few scattered bricks of these structures. The other historical aspect for which Grand Terre is well known is that it was once the headquarters of Privateer Jean Lafitte's operations. Much folklore surrounds this part of history, but no physical remains of the operation have been found on the island.



Sediment restoration on Trinity Island. Map Courtesy of UNO Pontchartrain Institute for Environmental Sciences.

Barrier Island Restoration in The Barataria-Terrebonne Estuary

The barrier islands of the Barataria-Terrebonne Estuary have benefited in recent years from federal funding through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), or Breaux Act. These funds provide between 20 to 80 million per year to Louisiana, which is matched by the State at a rate of 15%. CWPPRA has funded many projects designed to slow the erosion that has been ravaging the Louisiana coast. The barrier island restoration projects generally use dredged material, which is pumped onto the islands from the floor of the Gulf of Mexico. This builds up the height and width of the islands, creating a more robust profile that can stand up to a storm surge more effectively. Restoration projects on Isles Dernieres and East Timbalier Island were completed in 2002. West Timbalier Island was completed in January 2005. In addition, there is a similar State project on Grand Terre Island.



Sediment restoration on Timbalier Island, showing the completed project and the impact of Hurricanes Katrina and Rita.

Aerial Photos of Trinity Island, before and after the restoration project.
Photos courtesy of Shea Penland