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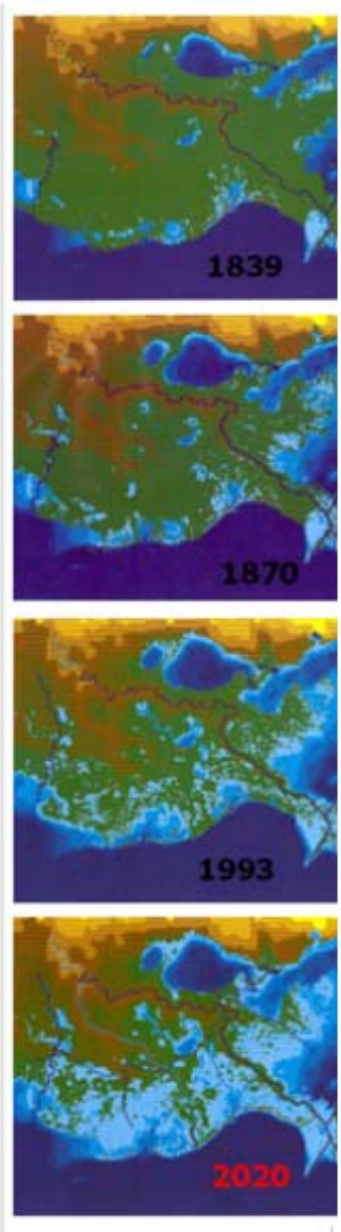
Erosion and Saltwater Intrusion Impacts to the Wetlands and Shoreline in the Louisiana Gulf Coast Region

Introduction

Coastal erosion and wetlands loss is a major problem along the Gulf Coast, particularly in Louisiana. Nearly half of the original wetland habitats in the United States have been lost over the past 200 years and although Louisiana's wetlands represent about 40% of the total wetland area of the nation, they contribute to nearly 80% of the present day loss of wetlands. Approximately 75 kilometers of Louisiana's wetlands are being lost annually. Scientists estimate that by 2050, Louisiana will have lost 640,000 acres of coastal wetlands, or approximately 1,000 square miles. This is an area about the size of Rhode Island. This is an area of great concern to both federal and state agencies involved in environmental protection and conservation, not to mention the citizens who live in the areas affected. Wetlands provide numerous valuable ecosystem services to the state of Louisiana, including flood and storm protection. Wetlands and barrier islands provide protection from strong winds and storm surges during hurricanes. It's estimated that for every 2.7 miles of wetlands in the storm's path, the storm surge can be reduced bout about 1 foot. Loss of these landforms leads to damage further inland during hurricane season, not only from the force of the water, but also from saltwater making its way into freshwater habitats. Saltwater inundation further inland is one of the factors that is exacerbating the problem of erosion and coastal habitat destruction, and it has many man-made causes.



Source: Environmental Protection Agency

Natural Deltaic Processes

Coasts and wetlands form the boundary between land and water, and their structure can be fragile and unstable. Coastal environments are constantly changing due to erosion of the soils

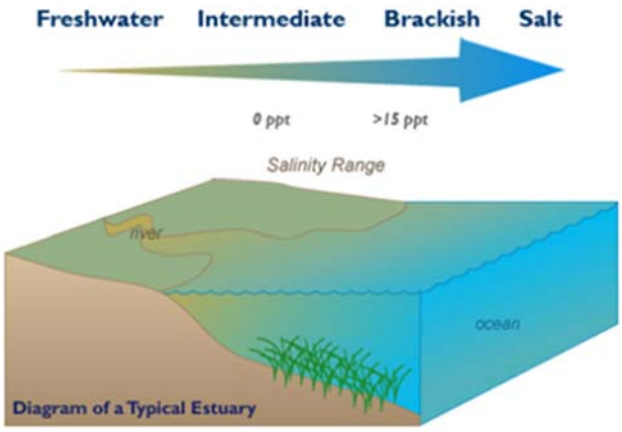
and deposition of new sediments, known as accretion. Breaking waves and tides, as well as wind action move sand, eroding in some areas and leaving deposits in other. Rivers also carry and deposit sediments to form the coastlines and deltas. When this process is out of balance, and there is more erosion than accretion, land mass along shorelines can be lost from coastal areas. Hurricanes and other severe storms can cause swift, dramatic erosion events from high winds and storm surges.

Anthropogenic Activity and Impacts to Deltaic Processes

Human activities can also affect erosion. One example is the levee and dam system constructed for flood control along the Mississippi River. These structures altered the natural hydrology of the area and disturbed the balance between sediment lost through erosion and gained through deposition and accretion. Commercial and residential development along waterways often can weaken the shorelines, especially if any type of dredging or construction of docks and harbors are involved. Construction and modification of harbors and inlets for navigation alters the landscape and hydrology of the area and can compromise the structure and strength of the shorelines, causing widening of the channels and shoreline creep. The Mississippi River Gulf Outlet (MRGO) is an example of the negative impacts of these types of projects. The MRGO is a man-made navigational channel constructed between 1958 and 1965 to connect the city of New Orleans to the Gulf of Mexico. Several impacts of the project include land loss due to excavation of the channel, erosion, and shits in habitat type due to saltwater intrusion and salinity changes. Wetland loss and shoreline deterioration due to the MRGO has made the outlet vulnerable to tidal surges from storms, which caused a major problem during Hurricane Katrina. The MRGO was deemed an imminent threat and closed to maritime traffic in 2009, with a storm surge barrier constructed.

The MRGO and an outlet into Lake Borgne, approximately 50 miles (80 km) up the canal from its mouth and 15 miles (24 km) east of New Orleans

Saltwater Inundation/Intrusion



Source: Seagrass Conservation Website

Saltwater from oceans can move inland, encroaching on freshwater systems and habitats. This can be a major driver of erosion and coastal habitat destruction. There are several natural causes for this, such as storm surges and droughts reducing the freshwater levels and allowing salt water to move into aquifers and groundwater. Climate change is also contributing in the form of more erratic and intense weather patterns and storms. Rising sea levels are also increasing saltwater inundation into groundwater aquifers and estuaries. This is due to higher than normal tide levels and increased storm surge levels.

Many strictly anthropogenic activities also contribute to salt water intrusion. Dredging and construction of canals for industrial transport has had devastating effects on the surrounding habitats. These canals allow saltwater to flow into wetlands, destroying the vegetation that holds the soil and sediment together in the marshes. Levees were once thought to be the main culprit of increased erosion and wetland loss due to blocking natural sediment deposition from the river, but the evidence is now suggesting that the activities of the oil and gas companies have been far more detrimental. The wetlands loss began in earnest after the canals started being constructed, even though the levees had been in place 100 years before then. Navigable waterways are prone to widening of the canals due to coastal erosion and shoreline creep, leading to increased threats of saltwater intrusion in the nearby fresh water marshes.

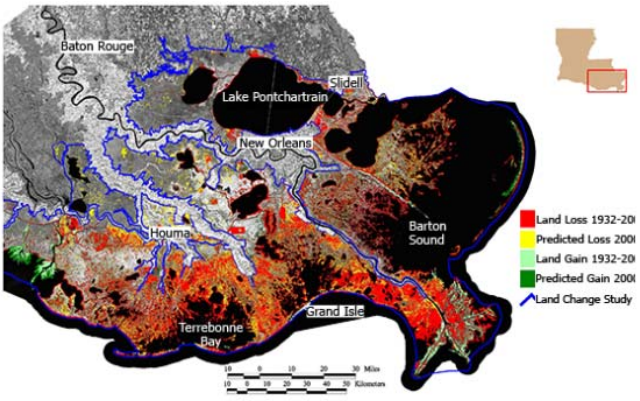

Dredged canals have destroyed Louisiana wetlands. Source: U.S. Geologic Society

Pollution killing off vegetation can also lead to increased erosion and allow further inland saltwater intrusion. Oil can destroy animals and vegetation through both chemical toxicity and physical smothering. These plants stabilize shorelines and hold the soil in place, so erosion is accelerated when the vegetation is destroyed. After the Deepwater Horizon spill in the Gulf of Mexico in 2010, oil damage to plants and oyster beds increased the erosion of marsh shorelines between 2010 and 2013. This increased erosion occurred along over 100 miles of shoreline throughout the Gulf of Mexico. While the marshes are expected to eventually recover, the eroded shoreline is a permanent loss.

Oil in marsh vegetation during the 2010 Deepwater Horizon/BP oil spill. (NOAA)

Effects of Saltwater Inundation

Saltwater intrusion can disrupt many wetland functions. The increase in salinity levels can hinder natural processes in wetlands such as denitrification and water quality management. Ecosystem and habitat destruction from saltwater intrusion is also a major concern. Freshwater marshes have undergone the largest reduction in area of any marsh types along the Louisiana gulf coast and in the Mississippi Delta during the last 20 years. This is mainly due to salt water intrusion, canal dredging, as well as development of commercial, industrial and residential properties. 25-50% of the original 1 to 2 million acres has been lost.



Map showing wetland loss in Louisiana. Modified from: LaCoast, U.S. Geologic Society

A "ghost forest" from chronic salt water intrusion in Terrebonne Parish, Louisiana. [CREDIT: U.S.G.S. National Wetlands Research Center]

Forested wetlands are often destroyed and become what is known as “ghost forests”, with the vegetation and trees dying from the increased salinity in the water. As with other wetland and marsh types, there is increased erosion due to loss of vegetation, which leads to even further saline intrusion.

House in Isle de Jean Charles after Hurricane Gustav in 2008.

The loss of land mass is not just a problem in undeveloped or uninhabited areas. Some coastal villages are being decimated by the erosion and land loss. One example is Isle de Jean Charles in Terrebonne Parish, Louisiana. This small island is inhabited with families who are members of the Biloxi-Chitimacha-Choctaw tribe of Native Americans. The island is believed to have been settled in the early to mid-1800s, after the Indian Removal Act of 1830, by Native American settlers wanting to avoid being transported to reservations. Since 1955, the size of the island has decreased from 22,000 to 320 acres, and dredging for oil and gas pipelines and canals was a major factor, along with hurricanes and storm surges.

Saltwater intrusion can also cause damage to water resources. Salt water can end up in streams, aquifers, and wells, damaging the water supply for surrounding areas and towns. For example, the aquifer systems in the Baton Rouge, Louisiana area are being affected by saltwater encroachment. Water quality could soon be affected by the saltwater once it reaches the pumping centers for the area.

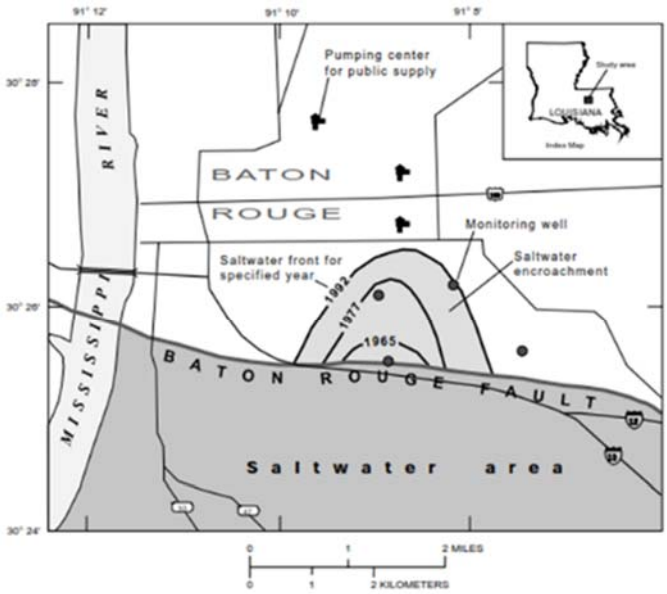


Figure 3. Saltwater encroachment in the "1,500 foot" aquifer toward pumping centers.

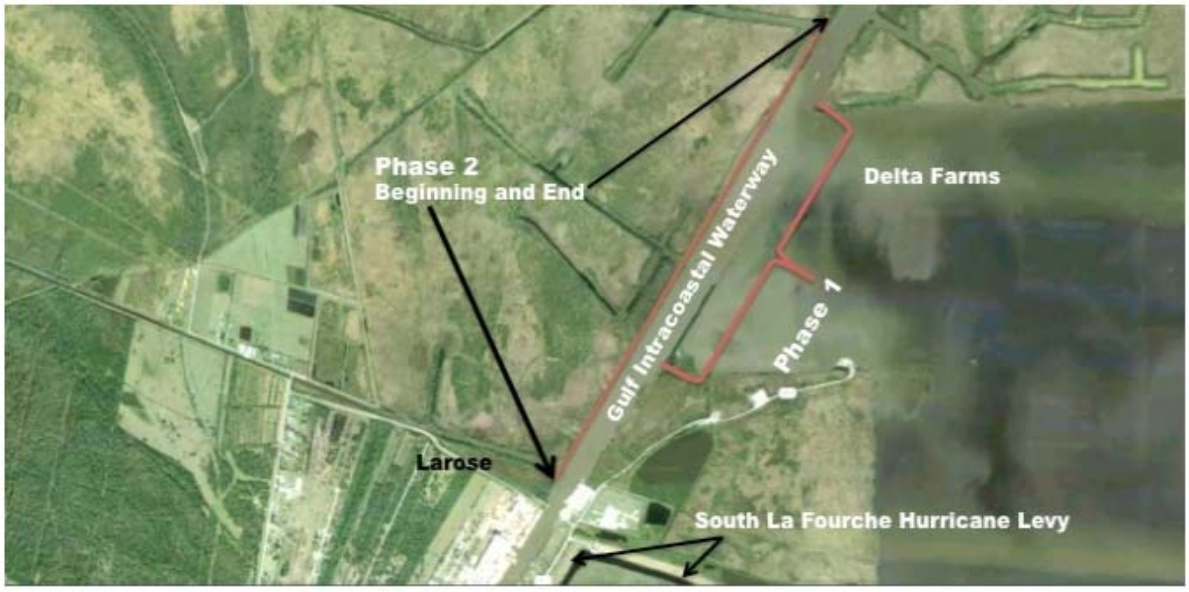
Restoration Efforts

Methods for controlling and mitigating saltwater inundation are being explored, as well as restoration of compromised shorelines and inlets that allow intrusion of saltwater into nearby freshwater systems. One such project is the Gulf Intracoastal Waterway (GIWW) Shoreline Stabilization & Restoration Project. It began in 2015 in Lafourche Parish, Louisiana. The Intracoastal has many areas of compromised embankments due to erosion, and they pose a threat of saltwater intrusion into the nearby freshwater marshes which would destroy crucial fish and wildlife habitats. Four miles of embankment along both sides was chosen for a demonstration project to shore up compromised areas. The first phase involved a 1 mile stretch of shoreline on the gulf facing side, and the second phase was to restore a 3 mile stretch on the north facing side. The restored areas will help protect the Larose, La community from storm surge, as well as the new living shoreline providing wildlife habitat. 24 acres of restored wetlands was established with the completion of this project.

This project involved a diverse partnership between the America's Wetland Foundation along with government agencies, non-profit conservation agencies, and private investors and landowners. The groups involved included the U.S. Army Corps of Engineers, Ducks Unlimited, several state agencies, as well as some corporate support from the energy industry. Private landowners were particularly interested in how cost effective this restoration project may be, since traditional processes for shoring up the embankments are expensive and require costly and complicated permitting processes.

Two of four layers of EcoShield™ installed into GIWW shoreline.

A combination of traditional and newer restoration technologies was used. Simple, lower cost procedures such as bucket dredging was used to help restore sediments along the shore. The application of a "living shoreline" was also part of the project, using marsh grasses deployed in a recycled plastic matrix called Vegetated EcoShield™ from a Baton Rouge based company called Martin Ecosystems. This living shoreline can help protect and strengthen the embankment by promoting vegetative growth, and is far more cost effective than traditional concrete embankments.



Conclusion

Coastal erosion and wetlands loss in south Louisiana is one of the most serious issues facing the state right now, and can have lasting consequences. The wetlands provide crucial ecosystems services such as habitat for wildlife and plants, water quality functions and storm protection, educational and recreation activities, and even economic loss due to damage to fisheries and seafood industry.

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