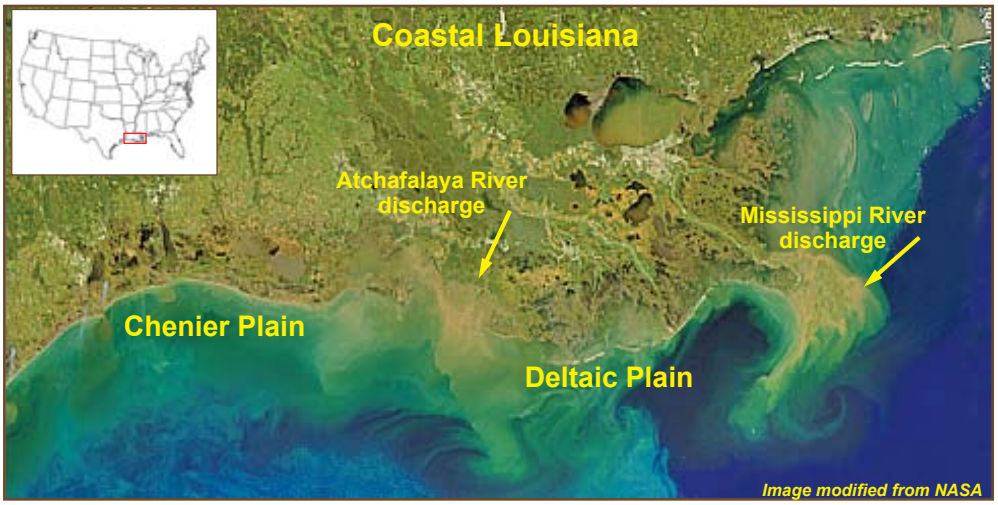
ENHANCING LANDSCAPE INTEGRITY IN COASTAL LOUISIANA: WATER, SEDIMENT & ECOSYSTEMS

Based on Conceptual Ecological Model Focus Group—March 2006 *Printed—July 2006*

The natural & human landscapes of coastal Louisiana are characterized by complex relationships among water, sediment & ecosystems. The sustainability of these landscapes is dependent upon critical processes that support the integrity of ecosystem features.

The Chenier & Deltaic Plains of coastal Louisiana were formed by different geologic processes. Direct deposition of river sediments formed the Deltaic Plain, while the reworking of river sediments helped form the Chenier Plain (named after the parallel series of beach ridges).



The Mississippi & Atchafalaya Rivers are major sediment sources for building land in coastal Louisiana.

These regions are also ecologically different and have different restoration options. Restoration in the Deltaic Plain centers around utilizing Mississippi River water & sediments to restore degraded habitat, whereas Chenier Plain opportunities focus more on utilizing water & sediments from the Atchafalaya River to preserve existing habitats & prevent continued degradation. The trade-offs in restoring Chenier & Deltaic coastal ecosystems are associated with how to optimally use riverine & sediment resources to support both natural & human systems.

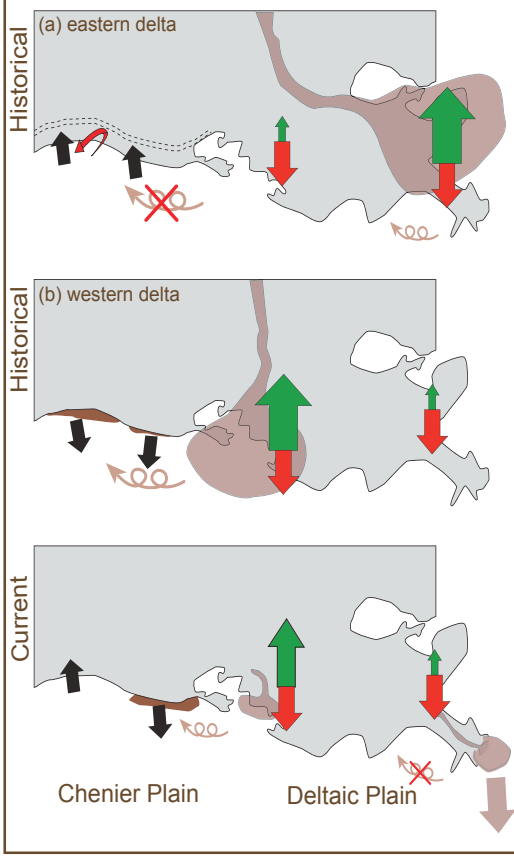
Forested chenier ridge in Hackberry, LA. *Photo by W. Barrow*

Wax Lake delta. *Photo by T. Carruthers*

Coastal Louisiana provides:

- 36% of U.S. shrimp commercial landings
- 50% of U.S. oyster commercial landings
- 26% of U.S. blue crab commercial landings
- Wintering habitat for over 3.5 million migratory waterfowl
- Home to over 50% of Louisiana's citizens

Sediment deposition patterns control land growth & loss in coastal Louisiana



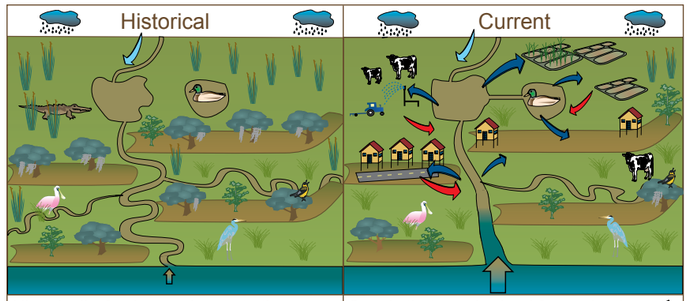
The Mississippi River shifts course every few thousand years. During an eastern alignment (a), delta-building occurs in that area as sediment accretion rates exceed those of subsidence (land sinking). Wetlands in the western delta that are not receiving sediment from the river cannot offset subsidence, resulting in wetland loss. When the river shifts to a western alignment (b), delta formation occurs there at the new river mouth. This new alignment eliminates the sediment supply to the previous eastern delta, thus reducing its ability to offset subsidence. This balance of growth & loss is repeated every time the river switches course, & this is how the Deltaic Plain was formed.

On the Chenier Plain, shoreline building occurs as sediment is resuspended by longshore currents when the river is in a western alignment (b). When the river switches to the east (a), sediment supply to the Chenier Plain is eliminated, & the shoreline erodes. Previously deposited sand remains along the shoreline & is reworked by natural processes to build chenier ridges.

Currently, flow in the Mississippi River is channelized by levees, resulting in sediment loss in the deep Gulf of Mexico. New delta building by the Atchafalaya River is not enough to balance this massive loss of sediment.

CHENIER PLAIN

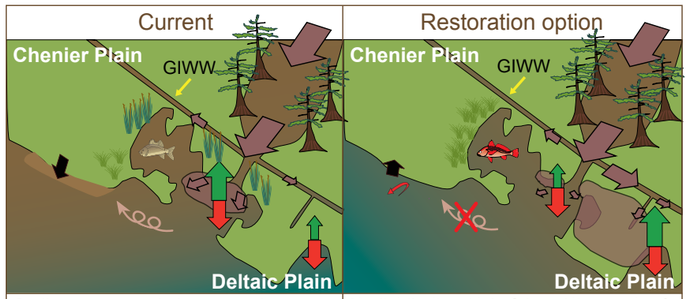
Chenier Plain hydrology



Historically, freshwater inputs to the Chenier Plain from upland runoff & precipitation drained through meandering rivers. Both fresh & brackish marsh were abundant between forested chenier ridges. Tidal exchange with the Gulf of Mexico was limited, & salt water intrusion was minimal.

Canals that are dredged for navigation & greater freshwater consumption of upland runoff & precipitation allow increased tidal exchange & salt water intrusion. Freshwater lakes are impounded to create reservoirs for rice & crawfish farming, & for waterfowl. Wastewater from agriculture has increased levels of nutrients.

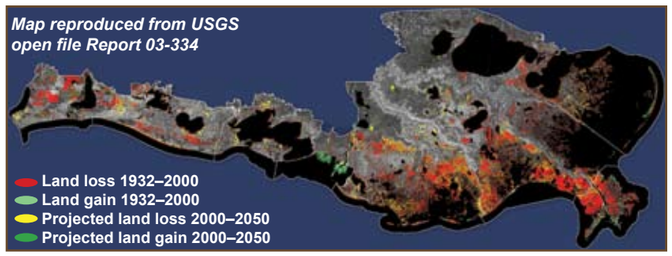
Trade-offs in Deltaic & Chenier Plain sediment use

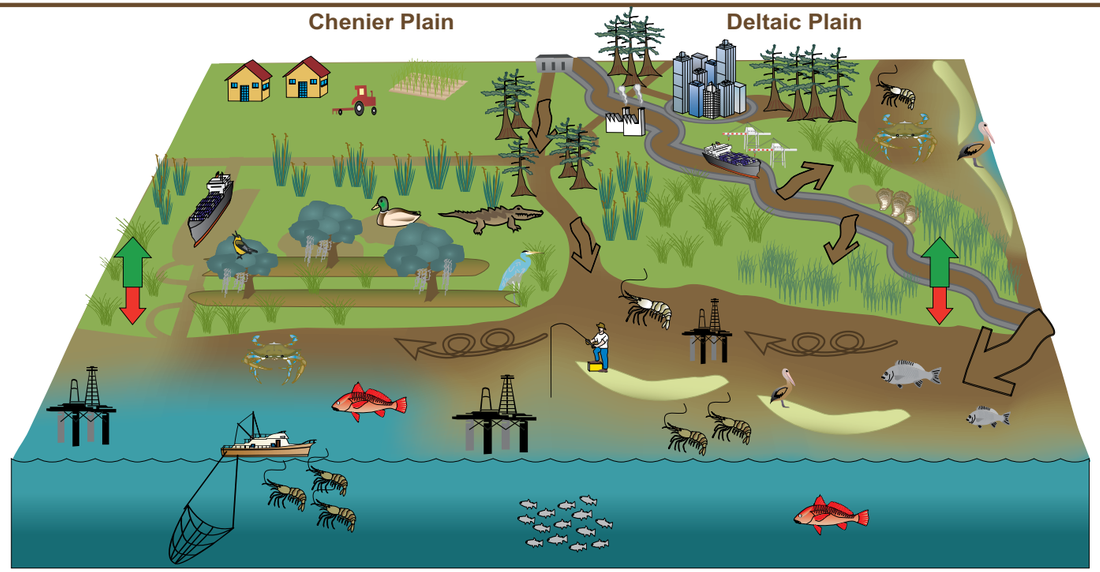


Sediment accumulation exceeds subsidence as sediment from the Atchafalaya River actively builds a new delta & nourishes adjacent wetlands. Atchafalaya sediment also builds the Chenier Plain shoreline through along-shore resuspension & transport. Currently, eastward movement of freshwater & sediment via the Gulf Intracoastal Waterway (GIWW) is limited. Coastal bays near the mouth of the Atchafalaya River are predominantly fresh to brackish water habitat.

Redistributing Atchafalaya River water & sediment to the east could nourish degrading marsh in the western Deltaic Plain so that accretion would exceed subsidence. Doing this without proper management (e.g., diverting additional water from the Mississippi River into the Atchafalaya) could compromise resources that sustain the Chenier Plain, resulting in coastal erosion & shoreline loss. With enhanced flow of water to the east, coastal bays near the mouth of the Atchafalaya would become more brackish.

Historical & projected land loss in coastal Louisiana: 1932–2050



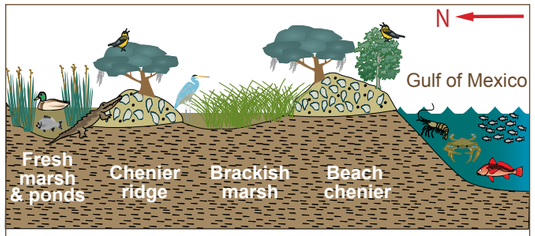


Landscape integrity supports a working coast

Lousiana's working coast relies heavily on the overall health & stability of the coastal landscape. Oil & gas activities, major port infrastructure, commercial fisheries, & numerous other industrial & economic drivers of coastal Louisiana rely upon the integrity of the coastal landscape. Coastal cities & small communities also rely on a healthy, intact coastal landscape for flood protection & recreational activites such as fishing & hunting. As our coastal landscape continues to degrade, so will our most treasured resources—including waterfowl, alligators, brown & white shrimp, blue crabs, oysters, coastal fisheries, & a host of others.

The integrity of the Louisiana coastal landscape includes the presence of barrier islands, beach & chenier ridges, extensive saline, brackish, & fresh marsh habitat, & also healthy swamp forests. To enhance the health of the coastal landscape, we must maintain a dynamic salinity gradient across the coast by promoting seasonal inputs of fresh riverine water. We must also maintain & enhance sediment sources that will elevate accretion rates beyond those of subsidence & sea level rise.

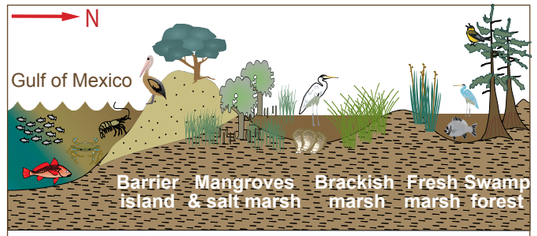
Ecosystems of the Chenier Plain



Common biota:
Songbirds
Wading birds
Blue crabs
Shrimp
Marine fish
Freshwater fish
Alligators
Waterfowl
Oaks
Fresh marsh
Brackish marsh

Sediment:
Shell & sand
Mud

Ecosystems of the Deltaic Plain



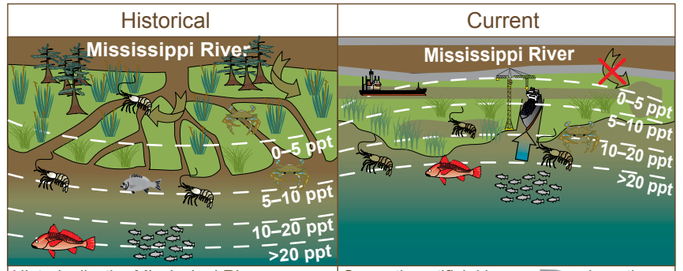
Common Biota:
Songbirds
Pelicans
Wading birds
Blue crabs
Shrimp
Oysters
Marine fish
Freshwater fish
Cypress
Fresh marsh
Brackish marsh
Salt marsh
Mangroves

Sediment:
Sand
Mud

Common habitat types in coastal Louisiana: inland–fresh to coastal–saline

DELTAIC PLAIN

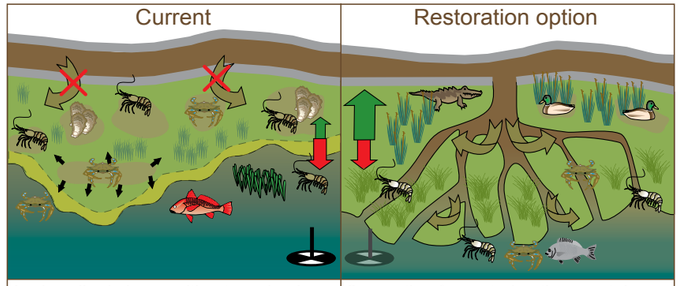
Deltaic Plain hydrology



Historically, the Mississippi River overflowed its banks every 3 to 5 years. This periodic supply of freshwater helped sustain a wide salinity gradient (0 to >20 ppt) & habitat types ranging from swamp forest to fresh & brackish marsh. White shrimp & other freshwater species thrived in the inland & nearshore waters, while marine species thrived further away from the shore.

Currently, artificial levees along the Mississippi River prevent overbank flooding. With less freshwater input, the coastal landscape is dominated by brackish & salt marsh. Saline water penetrates inland via straight, deep navigation channels, additionally reducing freshwater habitat. Under the current saline conditions, brown shrimp are more abundant than white shrimp, & marine species move closer to the shore.

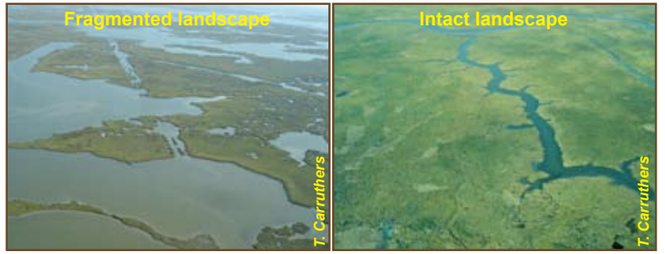
Trade-offs in riverine sediment use



As described above, without overbank flooding, sediments have also been eliminated from the Deltaic Plain marshes, resulting in subsidence (sinking) that exceeds sediment accretion. Areas that were land become open water as the landscape fragments & sinks. Without regular input of sediment-rich water, the coastal waters are typically less turbid (clearer) & more saline, which provides conditions favorable for oyster production & seagrass habitat.

One option for restoring the coastal landscape is to reconnect the river to the wetlands using large-scale river or sediment diversions. The influx of sediment-rich river water would cause accretion to exceed subsidence, resulting in a net gain of land area. As sediment-rich river water is introduced, the coastal water becomes more turbid (less clear), resulting in the loss of oyster & seagrass habitat.

Examples of fragmentation & landscape integrity



CONCLUSIONS AND RECOMMENDATIONS

Hydrology

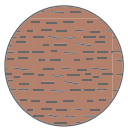
Hydrologic linkages within the coastal landscape have been disconnected & modified, resulting in the loss of ecosystem services.

Utilize regional water management options that maintain linkages to reconnect sediment & nutrient delivery to interior wetlands & reduce sediment loss to offshore environments.

Restore & maintain regional water flow patterns by mimicking natural processes & cycles & minimizing the impact of artificial waterways & structures.

Sediments

Reduced sediment delivery & retention have contributed to the deterioration of the coastal landscape.



Deliver new sediments to coastal basins using techniques such as river diversions & pipeline conveyance, or by utilizing longshore currents to rebuild & maintain the coastal landscape.

Enhance soil formation with organic matter production by reducing flooding & salinity stress on wetland vegetation.

Ecosystems

Loss of coastal habitats puts ecosystems at risk.

Reduce fragmentation while maintaining access of estuarine habitats to optimize for fish & shellfish diversity & abundance.

Maintain estuarine gradients & landscape features to support a diverse array of habitats & associated plants & animals, including resident & migratory bird communities.

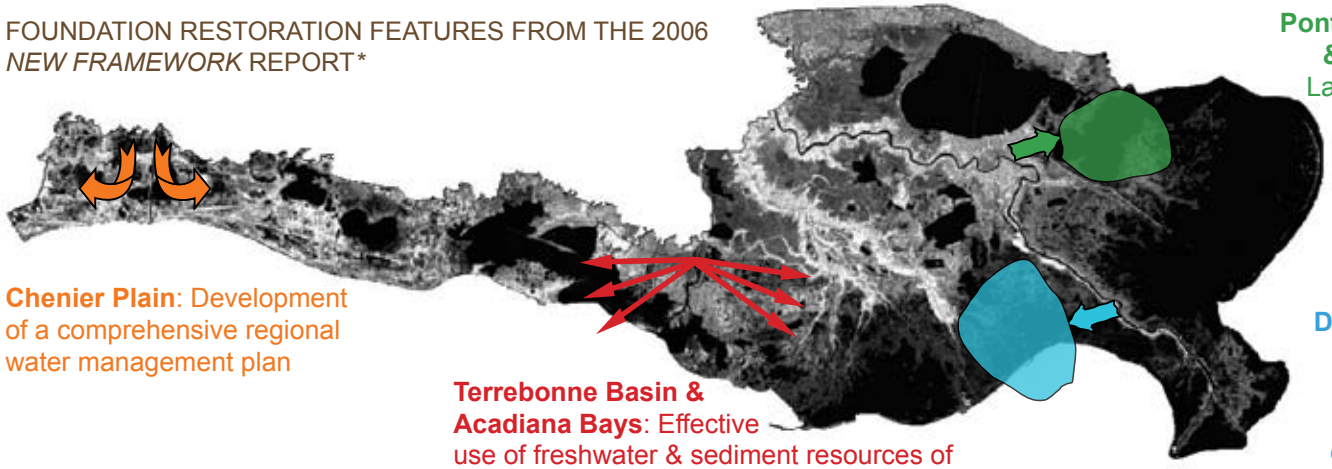
Landscape integrity

Landscape integrity has been compromised by alterations to hydrology, sediment distribution, & thus to ecosystems.

Encourage restoration projects that are of a scale sufficient to sustain & expand a variety of coastal landscape features.

Integrate the location of restoration activities with the complex needs of the working coast.

FOUNDATION RESTORATION FEATURES FROM THE 2006 *NEW FRAMEWORK* REPORT*



Pontchartrain Basin & Breton Sound: Large land-building diversion into Lake Borgne

Barataria Basin & the Birdfoot Delta: Large-scale reintroduction of riverine water & sediments to the coastal boundary region rather than the shelf.

Chenier Plain: Development of a comprehensive regional water management plan

Terrebonne Basin & Acadiana Bays: Effective use of freshwater & sediment resources of the Atchafalaya & other existing channels

* Working Group for Post-Hurricane Planning for the Louisiana Coast. 2006. A New Framework for Planning the Future of Coastal Louisiana after the Hurricanes of 2005. Available at *www.clear.lsu.edu*

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FURTHER INFORMATION Coastal Louisiana Ecosystem Assessment & Restoration (CLEAR) www.clear.lsu.edu

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