Wetlands, Land Loss Processes, and Sea Level Rise in Louisiana

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What are Wetlands?

Wetlands are low lying lands with spongy soil that are wet for a certain time every year. The types of plants that grow from wetland soil are dependent on water saturation to grow and survive. There are two types of wetlands in Louisiana: **Marshes** and **Swamps**. A **marsh** is a wetland with no trees. The plants growing here are grasses, reeds, sedges, and some shrubs. A **swamp** is a wetland that is usually characterized by the growth of woody plants such as cypress and tupelo trees.

Wetlands can be either saltwater, or freshwater. A wetland composed of a mixture of both salt and freshwater is called an **estuary**.

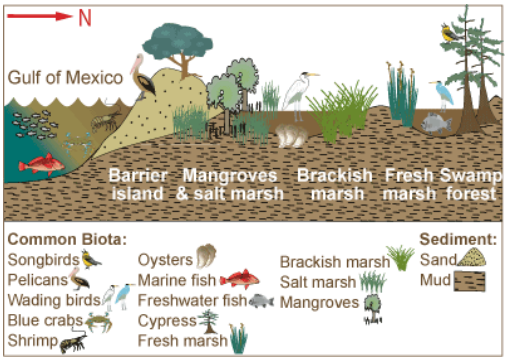
In addition to providing habitats for plants and animals, wetlands store flood waters, protect and improve water quality, and maintain surface water during dry periods (EPA). Wetlands store water and release it in increments, slowing the speed of water, and thus, slowing **erosion**. The ability of the wetlands to store water also reduces flood levels, decreasing damage to property and land. Wetlands also "allow **ground water recharge**, which contributes to base flow to surface water systems during dry periods" (EPA). This means that surface water is absorbed by wetland soils and held there for later use when water is scarce, making wetlands very valuable to the whole ecosystem during a drought.

In addition, wetlands protect and improve water quality by slowing the water flow enough that **sediment** drops down to the wetland floor rather than being swept along in the current. The water slows down because it has to make its way among many plants, and thus cannot sustain the same **momentum** it would have in open water. This also applies to many pollutants carried in the water. Just like sediment, once the **current** decreases in speed, **pollutant** particles in the water fall to the floor of wetlands, and are then absorbed by plant roots and microorganisms in the soil (EPA). This helps purify the water before it continues on its way. For this reason, water usually leaves a wetland much cleaner than it was when it entered.

The Importance of Louisiana's Wetlands

Wetlands are a site of great **bio-diversity**. "Wetlands are some of the most biologically productive natural ecosystems in the world, comparable to tropical rain forests and coral reefs

in their productivity and the diversity of species they support" (EPA). This is largely because of the combination of water and land that composes a wetland. In wetland environments, both land and water organisms are capable of co-existing, so both varieties are found there in abundance.



Wetland environments are full of diverse vegetation and a plethora of nutrients. Like anywhere green plants exist, the energy converted by plants during **photosynthesis** is passed through the food chain to all of the animals of a wetland habitat, including humans (EPA). However, what makes a wetland special is the co-habitation of water and land organisms. This means more energy is being produced and consumed than in lands of more sparse vegetation or population, thus a diverse population can thrive there.

In addition, the relatively shallow waters of wetlands make it harder for underwater predators to stalk their prey, because water plants found here are used by fish and other animals for protection. Since fish and their eggs can hide from predators quite comfortably among the plants of the wetlands (Beach Chair Scientist), these lush areas become ideal places for mating and raising young with less threat of danger than the open water. Likewise, the slower waters of the wetlands are less likely to wash away nests or other animal homes.

However, wetlands are not only the habitat of animals, but people. Access to water is a human necessity. Without water there can be no **crops** or **livestock**, and without crops and livestock humans cannot survive in **sedentary** settlements. Thus, people settle by fresh water.

Furthermore, throughout history the people who control a fresh water source have been the people in power, but that has changed greatly with the rise of **industrialization**, **globalization**, and political and economic systems of **commerce**. Due to the global re-distribution of resources by the more wealthy investors in the global economy, proximity to water in developed countries is no longer necessarily a factor in survival.

Nevertheless, the Mississippi River still ships sixty percent of all United States grain exports through the Port of New Orleans, and "the agricultural products and the huge agribusiness industry that has developed in the basin produce 92% of the nation's agricultural exports, 78% of the world's exports in feed grains and soybeans, and most of the livestock and hogs produced nationally" (NPS). The Mississippi River and its ports, and the natural resources of the wetlands, are how millions of people in Louisiana make their livings and sustain their families.

The Importance of the Mississippi River and the Gulf

The Mississippi River is surrounded by human settlements. It " is one of the world's major river systems in size, habitat diversity and biological productivity….[and] is the… longest river in North America, flowing 2,350 miles… from Lake Itasca through the center of the continental United States to the Gulf of Mexico" (NPS). The Mississippi River is the spinal cord of American commerce, and it was also essential in the formation of the land we now call America.

Through a process called **sedimentation**, rivers form land around themselves. Rivers not only carry water in their **current**, but **silt**, **sand**, and **clay** (collectively known as **sediment**) from higher up in the river and from the river banks. This sediment is then deposited all along the river where there are bends in the course (because this is where some sediment becomes trapped and piles up) and especially at the **delta**, or the mouth of the river. Over centuries, rivers deposit this sediment around themselves until the land is built up so much that the river changes course. In other words, the river creates its own **levees**, which eventually cause the river to change its course and begin depositing sediment elsewhere.

However, people have also learned to make their own levees. The Mississippi has been corralled by us with man-made levees to stay in one place as long as we can make it, because if the river were to change course it would flood many cities and settlements, displacing millions of people, and destroying countless homes and communities. The Mississippi staying put is desirable because it would prevent the immediate displacement of all of these people and communities, but not allowing the river to change course will have the same effect in the long run.

The coast of the **Gulf of Mexico**, being exposed to the constant ebb and flow of the ocean as well as many devastating **hurricanes**, is **eroding** away. Unfortunately, because the Mississippi River is not allowed to change its course, it cannot deposit its sediment anywhere else in the delta or along the coast where this sediment is desperately needed to counteract erosion. This means that the coast and wetlands are disappearing at an alarming rate. Storms, **sea level rise**, and **subsidence** are all contributing to the disappearance of the Louisiana coast. It seems no matter what is done, these communities are in danger of being washed away.

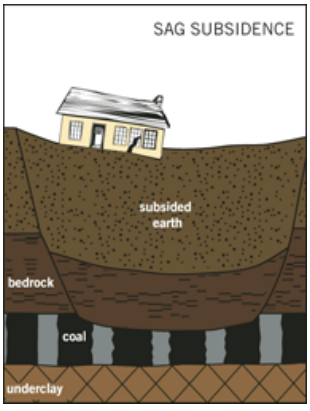
The Crisis of Wetland Loss

"Louisiana contains approximately 40% of the United States' wetlands and experiences 90% of the coastal wetland loss in the lower 48 states. 60% of Louisiana's land loss occurs in the Barataria and Terrebonne basins. At current land loss rates, nearly 640,000 more acres, an area almost the size of Rhode Island, will be under water by 2050" ("Louisiana Coastal Facts" *Restore or Retreat*). If the Louisiana coast disappears, so do most of America's wetlands, and all of the biological and ecological diversity in it.

The USGS states that Louisiana experiences 90% of the total marsh loss in the continental United States, and at the rate of land loss present today, Louisiana stands to lose one third of its coast by the year 2050 (USGS). "Wetlands and barrier islands provide a protection barrier from strong winds and hurricanes: every 2.7 miles of wetlands absorbs one foot of storm surge" (Restore and Retreat). Each mile of wetlands that disappears leaves the ground upland from them more exposed to the ferocity of hurricanes, high velocity winds, and storm surge. Since this is where most of the population in Louisiana resides, fewer wetlands mean higher property loss, displacement, and death tolls.

The loss of Louisiana's coast and wetlands would be economically and physically devastating to Louisiana and the nation. It would erase long-standing fishing and seafood-harvesting grounds; it would rip away the habitats of countless diverse animals, make homeless and destitute millions of people, and destroy the wonderfully diverse and unique **culture** that distinguishes Louisiana from anywhere else.

The Causes of Wetland Loss



Several main factors contribute to wetland loss in Louisiana: subsidence, sea level rise, and human disturbance.

<u>Subsidence</u>

Subsidence is "the gradual sinking of coastal land into the ocean due to geological movement of deposits along tectonic fault lines and the compaction of loosely deposited sediments" (USACE). According to NOAA, this sinking has been happening since the last ice age because "the accumulation and compaction of several hundred feet of sediments … has pushed the southern edge of Northern America downward, causing the Earth's lithosphere to bend" (NOAA). Thus, in the long-term, the North American tectonic plate is sinking. However,

subsidence in Louisiana is also occurring for other reasons with more immediate consequences. As more and more sediment is deposited and accumulated in the same place (as with the Mississippi River) and the compaction of deposited sediments occurs, eventually the weight and pressure of this sediment causes the air spaces between individual pieces of sediment to be compressed to the point that the land sinks.

Relative Sea Level Rise

There are two different kinds of sea level rise. **Eustasy** is the "world-wide sea level regime and its fluctuations, caused by absolute changes in the quantity of seawater, e.g. by continental ice cap fluctuations" (Geology slideshow). Eustatic sea level rise is measured from the surface of the water to the center of the Earth or some other fixed point. Eustatic sea level rise is occurring today due to the melting of the ice caps at the poles of our planet.

Relative sea level, on the other hand, is a measure of the height of an ocean body compared to the ocean bottom, or the sediment floor (Geology slideshow). The Department of Natural Resources defines relative sea level rise as "the sum of global (eustatic) sea level change plus changes in vertical land movement at a particular location due to **tectonic**, **neotectonic**, and **anthropogenic** impacts" (inFocus). Thus, subsidence affects relative sea level rise, but would not have much impact on eustasy unless it was occurring on a worldwide scale.

Relative sea level rises due to a combination of "tectonic subsidence or uplift of a basement datum, sediment compaction involving subsidence of a datum within the sediment pile, and vertical eustatic movements of the sea surface" (Geology slide show). As discussed earlier, subsidence and sediment compaction are both occurring in Louisiana, and due to climate change, eustatic sea level is also rising.

All of these factors have combined to cause the sea level of Louisiana's coast to rise, and in Louisiana, rising sea levels mean less land for people and humans. Loss of land means loss of the **habitat**, **ecosystem**, and the **economy** that are all sustained by Louisiana wetlands. Shrinking land space coupled with global over population mean less resources to go around.

Human Disturbance

The oil and gas industry is a main contributor to the loss of coastal Louisiana land. Oil and gas exploration has **channelized** the coastal zone to its breaking point, injecting salt water into freshwater habitats and killing freshwater ecosystems and increasing erosion (USACE).

As discussed in the "Importance of the Mississippi River" section, man-made **levees** have also contributed to wetland loss. They protect the human populations who have settled around the river from the decimation of their property, but they also do not allow the river to flood and replenish the land around it with sediment that would counteract subsidence and sea level rise (NOAA).

Another human disturbance that has contributed to wetland loss is the introduction of **invasive species** such as the **nutria** rat (that eats and destroys vegetation vital to wetland ecosystems), and other plants that usurp resources from and kill indigenous plants. These species characteristically reproduce quickly and abundantly when introduced to their new habitats because of a lack of natural predators. Invasive species are introduced to new lands by people who bring them back from their travels and do not think about the effect these new species will have on an ecosystem that was not made for them (NOAA).

<u>Other Causes</u>

Other contributors to coastal land loss are coastal storms and lack of bedrock. As mentioned before, the Mississippi Delta has been built up over thousands of years by the deposition of sediment carried along the Mississippi River. The whole of North America's land mass rests on a **tectonic** plate which ends at the continental shelf in the Gulf of Mexico, right below the **Mississippi Delta**. The land of the Mississippi Delta on top of this plate, however "is naturally subsiding because it is built on Mississippi **silt**, instead of the firm **bedrock** that the rest of North America sits on" (NOAA).

Coastal storms such as Hurricanes Katrina and Rita can also detrimentally advance coastal land loss. High winds, flooding, and "**salt water intrusion** from coastal storms erodes barrier islands, killing native vegetation and accelerating erosion" (NOAA) at an alarming rate. For example, though the typical rate of coastal land loss in Louisiana is 16 square miles per year, which is alarming in itself, Hurricanes Katrina and Rita eliminated 217 square miles of coastal wetlands in just two days' time (USACE).

Economic Effects

Due to the large amount of biological and ecological diversity of the wetlands, loss of the Louisiana wetlands would eradicate the habitats of fish, **waterfowl**, and other wildlife, as well as a major migratory path for birds of all of the Americas. The loss of these lands and animals would "cost the nation $36.6 billion from lost public use value over the next 50 years." (Restore and Retreat).

Louisiana also has the most productive fisheries in all 48 continental states, and is number one in harvesting oysters, shrimp, crabs, crawfish, red snapper, wild catfish, sea trout, and mullet. If the rate of land loss in Louisiana remains stable, "by 2050, the annual loss of commercial fisheries will be nearly $550 million. For recreational fisheries, the total loss will be close to $200 million a year" (Restore and Retreat).

Louisiana is the top producer of domestic oil (with $70 billion in annual revenue) and the top fisheries producer in the continental US with $3 billion annual revenue. If nothing changes, the fishing industry is projected to lose $37 billion by the year 2050 (USACE). If Louisiana were to continue to disappear at its current rate, the resulting retreat of inhabitants out of Louisiana would not only affect the state but the whole country. "18% of U.S. Oil Production; 24% of US natural gas production originates, is transported through, or is processed in LA coastal wetlands, [and] one fourth of our nation's energy supply depends on the support facilities in South Louisiana" (Restore and Retreat).

Louisiana ships the most cargo in the nation along the Mississippi and other waterways. The loss of Louisiana land at the current rate would expose "more than 155 miles of waterways and several of the ports…to open water within 50 years" (Restore and Retreat). This would make them highly susceptible to damage and destruction by storms. Every mile of wetlands lost means less protection for inhabitants of Louisiana's coast and costs an "estimated $5,752,816 average annual increase in property damage" (Restore and Retreat) due to storms. Approximately 70% of the population of Louisiana (a percentage equaling about 2 million people) lives within 50 miles of the coast and will be left completely unprotected from storms, or homeless, by 2050 if the rate of land loss does not decrease.

Glossary of Terms

A

Anthropogenic: created by people or caused by human activity.

B

Bedrock: unbroken solid rock, overlaid in some places by soil or rock fragments.
Biodiversity: variety among and within the living things of an environment

C

Channelization: Cutting straight lines through the marsh to more efficiently get from place to place.
Commerce: an interchange of goods or commodities, especially on a large scale between different countries.
Crops: The cultivated produce of the ground, planted and harvested for sustenance.
Culture: all of the aspects of a human life that are determined by one's nurture and nature. Culture often serves to differentiate between groups of people and strengthen bonds within groups.
Current:
Cypress Tree: a conifer of the genus Cupressus, characterized in Louisiana by its abundance in swamps and possession of cypress "knees", which are the roots of the tree that grow out of the water.

D

Delta: the flat alluvial area at the mouth of some rivers where the mainstream splits into several distributaries.
Dredging: removing sand, silt, mud, and other sediment from the bottom of a waterway.

E

Economy: the management of the resources of a community, country, etc., especially with a view to its productivity.
Ecosystem: the interactions of organisms with their particular environment.
Erosion: the process by which earth, rock, soil, are worn away by the forces of water or wind.
Estuary: The part of the mouth or lower course of the river in which the river's current meets the sea's tide.
Eustasy: any uniformly global change of sea level that may reflect a change in the quantity of water in the ocean, or a change in the shape and capacity of the ocean basins.

G

Globalization: worldwide integration and development.
Grasses: any plant of the family Gramineae, having jointed stems, sheathing leaves, and seed-like grains.
Ground Water Recharge: absorption of surface water by wetland soils.
Gulf of Mexico: the gulf of the Atlantic Ocean surrounded by the U.S., Mexico, and Cuba.

H

Habitat: the environment in which an organism lives.
Hurricane: a violent, tropical, cyclonic storm of the western north Atlantic, having wind speeds of or in excess of, 72 miles per hour.

I

Industrialization: The large-scale introduction of manufacturing, advanced technical enterprises, and other productive economic activity into an area, society, country, etc.
Invasive Species: foreign organisms characterized by their tendency to reproduce quickly and usurp detrimental amounts of natural resources from indigenous populations.

L

Levee: an embankment designed to prevent the flooding of a river. A deposit of sand or mud built up along, and sloping away from, either side of the floodplain of a river.
Livestock: animals kept for domestic use.

M

Marsh: A tract of low wet land, often treeless and periodically inundated, generally characterized by a growth of grasses, sedges, cattails, and rushes.
Mississippi Delta: The mouth of the Mississippi River.
Momentum: The force or speed of movement.

N

Neo-tectonic: The study of the motions and deformations of the Earth's crust which are current or recent in geologic time.
Nutria: American name for the "coypu", a large south American aquatic rodent, introduced to Louisiana's wetlands by foreign settlers and fur trappers.

P

Photosynthesis: the synthesis of organic compounds from carbon dioxide and water in plants using light absorbed by chlorophyll that produces energy and oxygen.
Plate Tectonics: the theory of global tectonics in which the Lithosphere is divided into a number of crustal plates, each of which moves on the plastic asthenosphere more or less independently to collide with, slide under, or move past adjacent plates.
Pollutant: any substance that renders the air, soil, water, or other natural resource harmful or unsuitable for a specific purpose.

R

Relative Sea Level: Position of the sea level relative to the land. Measures land movement versus the water movement over time.

S

Salt Water Intrusion: the movement of saline water into freshwater aquifers.
Sea Level Rise: the sum of global (eustatic) sea level change plus changes in vertical land movement at a particular location
Sedentary: abiding in one place; not migratory.
Sediment: the matter that settles at the bottom of a liquid.
Sedimentation: the deposition or accumulation of sediment.
Silt: Earthy matter, fine sand, or the like, carried by moving or running water and deposited as sediment.
Swamp: a tract of wet spongy land, often having a growth of certain types of trees and other vegetation, but unfit for cultivation.

T

Tectonic: forces or conditions within the Earth which cause movements of the crust.
Tupelo Tree (*Nyssa aquatica*): a tree having ovate leaves, clusters of minute flowers, and purple, berrylike fruit

W

Waterfowl: a water bird, especially one who swims.
Wetlands: a low lying area of land that is saturated with moisture, such as a marsh, swamp, or bog.

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