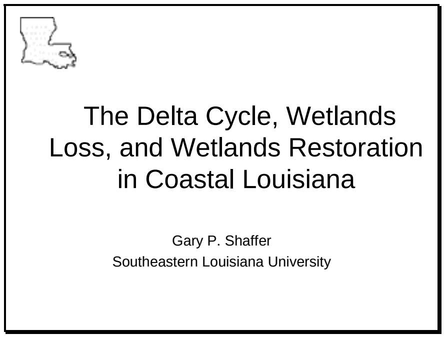
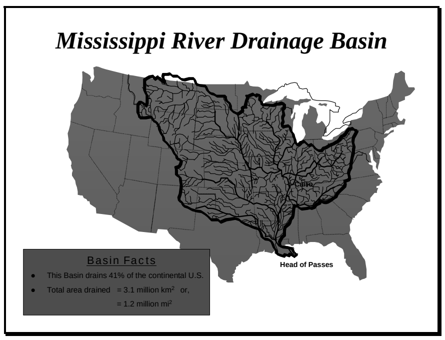
Slide 1



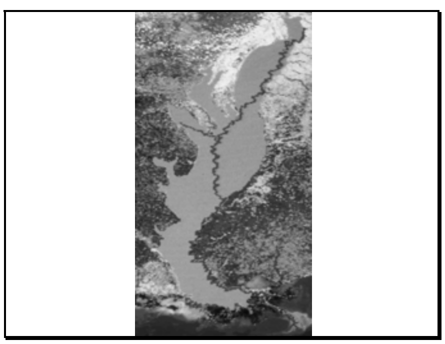

This presentation contains several animated slides and these will only animate under the regular presentation mode (i.e., the third button on the bottom left of the screen. You may want to run through the animation first, then come back and work through this story board version.

Slide 2



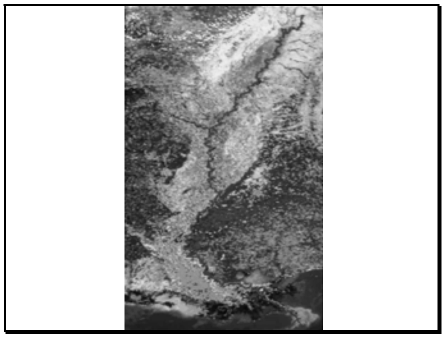

The watershed of the Mississippi is vast (see statistics above) and there once existed an immense expanse of forested wetlands from Cairo, IL to Head of Passes, LA.

Slide 3



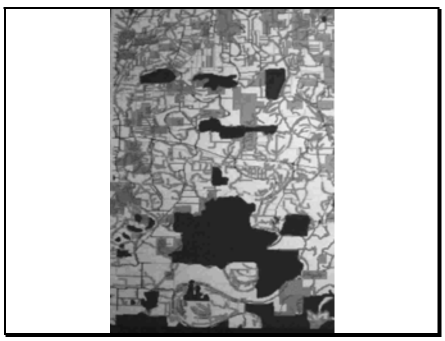
Using historic maps of great floods during the late 1800s and soils data, we estimated that these forested wetlands once covered 21-million acres (bright green area above; Illinois is at the top of the screen and the Gulf of Mexico is at the bottom).

Slide 4



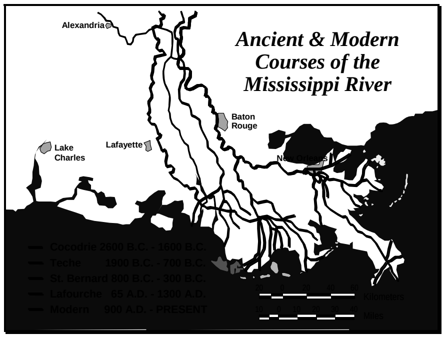
These wetlands have been reduced (by nearly 80%) to 5-million acres, 95% of which reside in Louisiana, Arkansas, and Mississippi. The majority of these forests were converted to soybean and cotton agriculture.

Slide 5



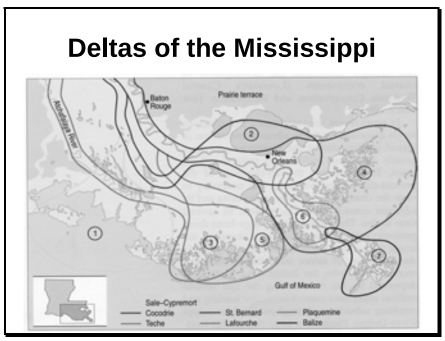
Beginning in the early 1990s and continuing today, The Nature Conservancy has spearheaded an effort to restore these forested wetlands. To do so, two features of the landscape are ideal for reconnecting forest patches (dark areas above in the Tensas Basin, LA), namely marginal agricultural land (land that is usually not profitable because it floods too often) and streams. All of the red features above are attempted corridors that failed because they crossed roads. The olive areas are marginal agricultural lands that could be used to re-connect forest patches and the bright green lines are streams that could be reforested and used as corridors. Over the last decade, The Nature Conservancy, through use of federal government incentives, such as the Wetland Reserve Program and the Conservation Reserve Program, has succeeded in helping private citizens reforest over 500,000 acres of land.

Slide 6



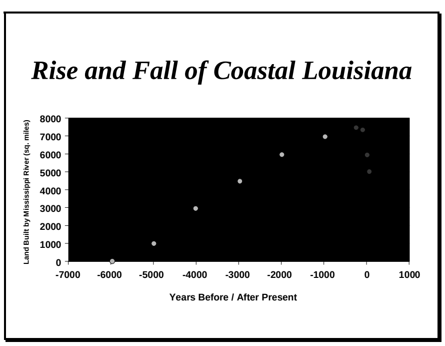

The Mississippi River changes course about once every 1,000 years as the old pathway (delta lobe) to the Gulf becomes inefficient. This happens as the delta lobe builds out into the Gulf and increases meandering. A new pathway ultimately develops during spring flood conditions. This new delta lobe increases hydrologic efficiency by shortening the path that water must take to get from the starting elevation to sea level in the Gulf of Mexico.

Slide 7



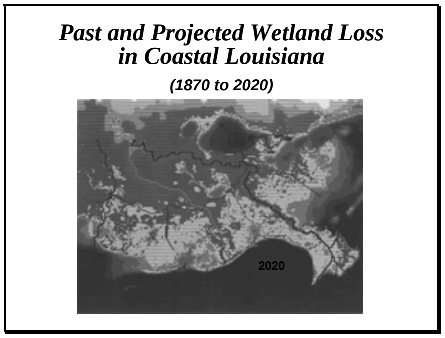

The abandoned delta lobes (1-6) no longer receive large quantities of sediment and naturally subside due to compaction and dewatering of the heavy sediments. Therefore wetlands loss in coastal Louisiana has been occurring naturally for thousands of years. In the past, however, the rate of wetland gain in the building delta has matched or exceeded the rate of wetland loss occurring in the abandoned delta.

Slide 8



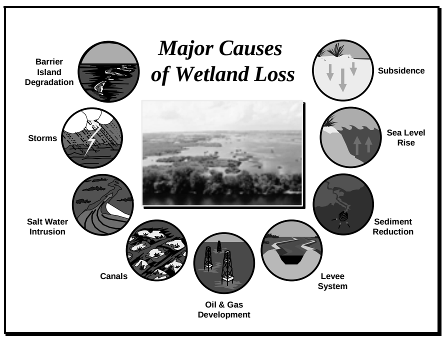

It is interesting to note just how long the delta-building process has been occurring in coastal Louisiana and how sharp the decline has been since humans have been altering the Mississippi River's natural hydrology by levee, channel, and road construction.

Slide 9




This animation demonstrates the alarming loss of coastal marsh. Even though wetland forests are degrading as well, they take longer to convert to open water than marsh and wetland loss estimates are currently underestimating loss of this important habitat.

Slide 10

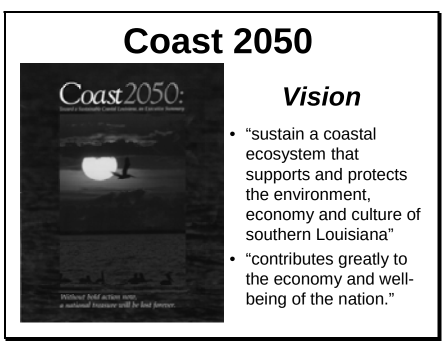



Many processes are responsible for wetlands loss in coastal Louisiana. The largest cause of loss arises from the leveeing of the Mississippi River which historically brought sediment, nutrients, and freshwater to Louisiana's coastal wetlands. Oil and gas exploration involves direct wetland loss through canal dredging and indirect loss via construction of "spoil banks" that impound wetlands. Canals also enable salt water from the Gulf of Mexico to move inland and poison salt-intolerant plant species (saltwater intrusion). Wetlands loss can occur through natural processes such as large storms and erosion of barrier islands. Furthermore, as sediments compact and dewater, they subside. This process is exacerbated by sea-level rise which further increases the amount of flooding; oxygen diffuses 10,000 times faster through air than through water, so increased flooding leads to lower oxygen levels in the soil and to the production of toxic chemicals. Because the River is leveed all the way to the Gulf of Mexico, enormous amounts of sediments and nutrients are dumped into deep waters where they trigger algae blooms and the production of “dead zones” (areas of water devoid or nearly devoid of oxygen). The equivalent of 220,000 dump trucks of sediment are lost to the Gulf *daily*.

Slide 11


Louisiana has established several programs designed to protect and restore its remaining coastal wetlands. Beginning in 1990, the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) spends about $40 million annually on specific projects designed to slow down wetland loss rates.

Slide 12




Another restoration program, launched in the late 1990s, is called Coast 2050. Coast 2050 sought to increase participation of public citizens in the development of a comprehensive coast-wide wetlands restoration program.

Slide 13


The Louisiana Coastal Area (LCA) program is the most ambitious and comprehensive wetlands restoration effort to date. Whereas about $600 million of CWPPRA funds have been spent on restoring coastal Louisiana over the past 15 years, the LCA program is seeking a total of $14 billion, with an immediate appeal for $1.8 billion.

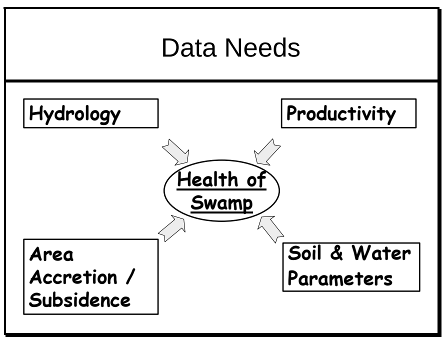
Slide 14


Many federal and state agencies cooperate on these wetlands restoration programs, and the scientific community is involved as well.

Slide 15

One way of restoring wetlands is by creating an opening in the levee of the Mississippi River and allowing regulated flow of water, sediment and nutrients into a target area. This is called a diversion. Amongst the first five projects to be funded under the LCA is a diversion of the Mississippi River into the degrading swamps of Lake Maurepas, which is located in the Pontchartrain Basin in southeastern Louisiana. This swamp is a mess; the trees are highly degraded with broken canopies. A massive study of this swamp was launched in 2000 and continues today. We are collecting data on the “health” of the swamp so that we can optimally design and construct the diversion, and accurately measure its benefits when it becomes operational.

Slide 16

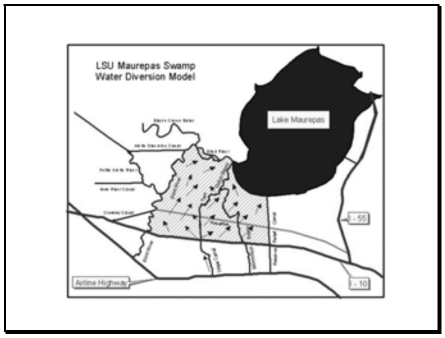



Specifically, Dr. John Day’s group at Louisiana State University has built hydrologic models that enable predictions to be made concerning the size of the diversion and its potential for triggering algae blooms. My group is measuring the growth rates of 2,500 trees as well as ground cover production, subsidence, soil strength, and salinity.

Slide 17


The first task involved choosing the optimal location for the diversion. The idea is to get the nutrient- and sediment-rich Mississippi River water to “sheet flow” over the swamp prior to reaching Lake Maurepas. This will allow the swamp to assimilate and denitrify the nutrients in the water so that algae blooms are not triggered. Locating the diversion at the third arrow from the left appears to optimize sheet flow.

Slide 18

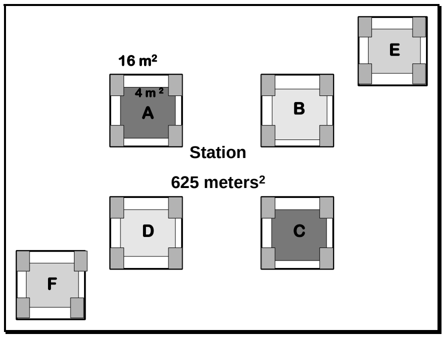



Hydrologic models indicate that the water will flow out over the swamp and take about 2 weeks to reach the Lake.  Over 90% of the nutrients will have been processed by then, just as in a sewage treatment plant.  Wetlands are natural filters.

Slide 19


Our study sites fall into four basic categories: (1) LAKE sites: the blue sites have exchange with the lake and are most prone to salt water intrusion; (2) INTERIOR sites: the white sites are deep into the swamp, and can only be accessed via airboat; (3) THROUGHPUT sites: the green sites have “throughput,” which means they receive nutrients from non-point sources such as neighborhood runoff; (4) AVERAGE sites: the orange sites are intermediate in their state of degradation.  You will see the site names (all caps) on graphs through the rest of the presentation.

Slide 20




Each permanent plot (located on the previous slide) is 625 square meters and contains six ground cover plots. The A and C plots receive time-released nutrients to simulate a small diversion, the E and F plots receive twice that amount to determine if a larger diversion would yield higher growth rates, and the B and D plots are untreated control plots to compare to the fertilized plots.

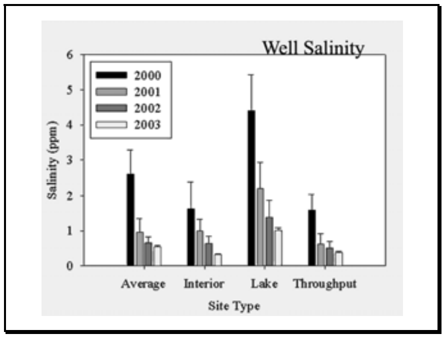
Slide 21

The gentleman on the left is measuring the electron availability of the soil, which indicates which, if any, microbial toxins are being produced.  The woman on the right is measuring soil subsidence with an instrument called a sediment elevation table (SET).

Slide 22

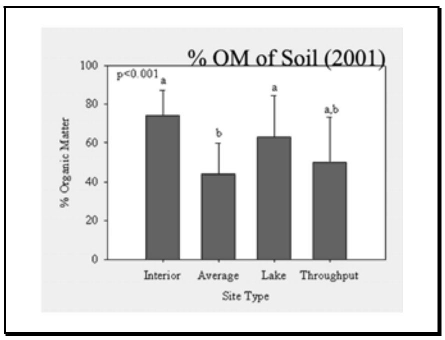
To measure tree growth, we collect leaf litter falling from the sky in 250 traps that are swept regularly.  In addition, diameter growth is measured annually on 2,500 trees.

Slide 23




Each site has two wells that we use to measure soil salinity. The drought of 2000 was accompanied by severe salt water intrusion events. Once the salt penetrates deep into the soils, it takes years to flush back out.

Slide 24




The percent of a soil that is organic rather than mineral can be a good indicator of soil strength. The soils of the Maurepas swamp are very weak. This ecosystem is primarily held together by living root tissue; if these roots die, the system could turn to open water rapidly.

Slide 25


This is a fertilized plot that has been browsed by deer or nutria. These animals can detect increased levels of protein in the fertilized plots.

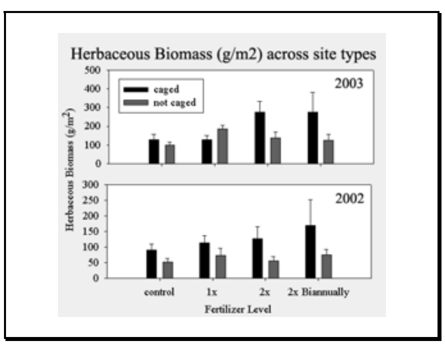
Slide 26

To foil their herbivory attempts, we built exclosures around each treatment type.

Slide 27

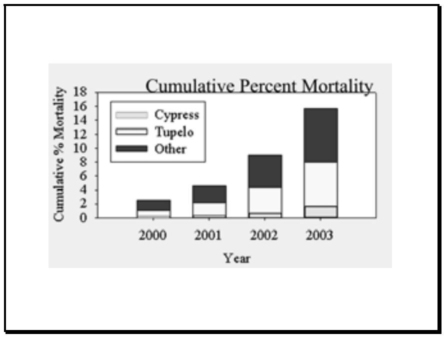
Within a few months the caged, fertilized plots were loaded with lush vegetation.

Slide 28



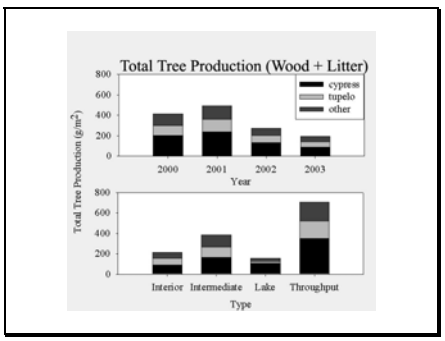

One interesting finding from the fertilizer study is the increase in biomass in the caged vs. uncaged control plots.  This is the amount of plant material that we were missing in our measurements because it was being eaten.  In all, it appears that the double-fertilized plots yielded greater than two-fold increases in ground cover biomass.  This is important, because fish and wildlife production generally follows plant production closely.

Slide 29



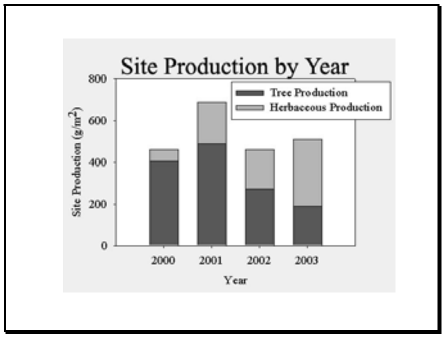

We expected the salt water intrusions during the drought of 2000 to kill some trees, especially tupelo, and ash and maple (called “Other” above), which are very sensitive to low levels of salinity. However, we did not expect mortality to continue into years 2002 and 2003, because salinities were low. Some of the sites near the margin of Lake Maurepas have experienced up to 30% mortality since 2000.

Slide 30



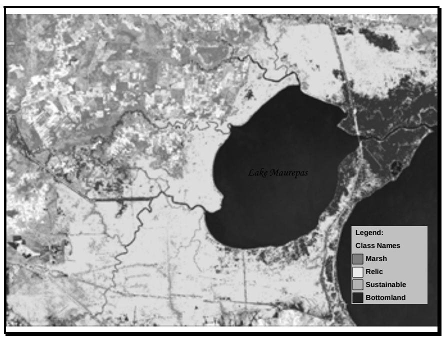

This slide demonstrates the importance of long-term field studies. In our first report we concluded that tree production was depressed during the drought year and returned to normal during 2001. In actuality, it appears that the low water levels during the drought enabled oxygen to penetrate the soils and this stimulated production overall. Then in 2001 the system freshened and remained relatively oxygenated. In 2002 and 2003, it appears that the soils have returned to their highly reduced state and that production averages about half of what we originally thought. Healthy swamps produce about 1,500 g/m2 of tissue per year, so production in the Maurepas is greatly depressed. Even the healthiest “throughput” are about half as productive as a healthy swamp. The “lake” sites are severely salt stressed, whereas the “interior” sites are essentially permanently flooded with stagnant, nutrient-poor water.

Slide 31




At the beginning of the study, the vast majority of plant tissue production was attributable to the trees. Over time this trend appears to be reversing as ground cover production compensates for decreased forest production. This may be a response of increased light levels reaching the ground as the forest canopy continues to degrade.

Slide 32




We used satellite signatures of our permanent sites to program a geographic information system to categorize four types of vegetation. Most of the area in red was forested as recently as the 1950s and has converted to marsh. The bright green areas are forest that may be healthy enough to regenerate if logged. The yellow sites are “relic” swamp which, if logged, will likely convert to marsh or open water. Finally, the dark green areas are raised elevations dominated by bottomland hardwood species such as oak and magnolia.

Slide 33


In all, our data indicate that a diversion of the Mississippi River into the Maurepas swamp would produce enormous benefits. Without a diversion this treasure will continue to decline.