Barrier Islands

Pontchartrain Institute for Environmental Sciences
University of New Orleans

BTNEP
BARATARIA-TERREBONNE NATIONAL ESTUARY PROGRAM

COASTAL WETLANDS PLANNING, PROTECTION, AND RESTORATION ACT

UNIVERSITY OF NEW ORLEANS

EDUCATORS' GUIDE

ABOUT THE AUTHOR

Dinah Maygarden has worked in the field of science and environmental science education for more than twenty years, beginning her career as a classroom science teacher and later holding positions at the Louisiana Audubon Nature Center and the Louisiana Cooperative Extension Service working on grant funded projects in environmental science research and education. She has worked on a number of curriculum development projects such as *Lessons on the Lake* (Lake Pontchartrain Basin foundation) and is co-author or contributor to many education publications. She has worked in her current position since 1997 at the University of New Orleans as a Research Associate and Manager of the Coastal Education Program at the Pontchartrain Institute for Environmental Sciences. In this position she has developed the Coastal Education Program, designed to increase awareness and understanding of the issues related to Louisiana's coastal wetlands. This program conducts field education for students in grades 4-12 and professional development workshops for teachers. Ms. Maygarden and her staff also develop multi-media educational materials for use by educators. Currently she is working on developing a field program at a new field facility, The Shea Penland Education and Research Facility in eastern Orleans Parish.

In addition, Ms. Maygarden has developed a summer program for high school students, which is part of an established minority recruitment program for the geosciences at UNO. This program has worked to introduce minority students to earth and environmental sciences through field experiences and research, with an emphasis on the Louisiana coast and more recently the western states such as Utah and Wyoming.

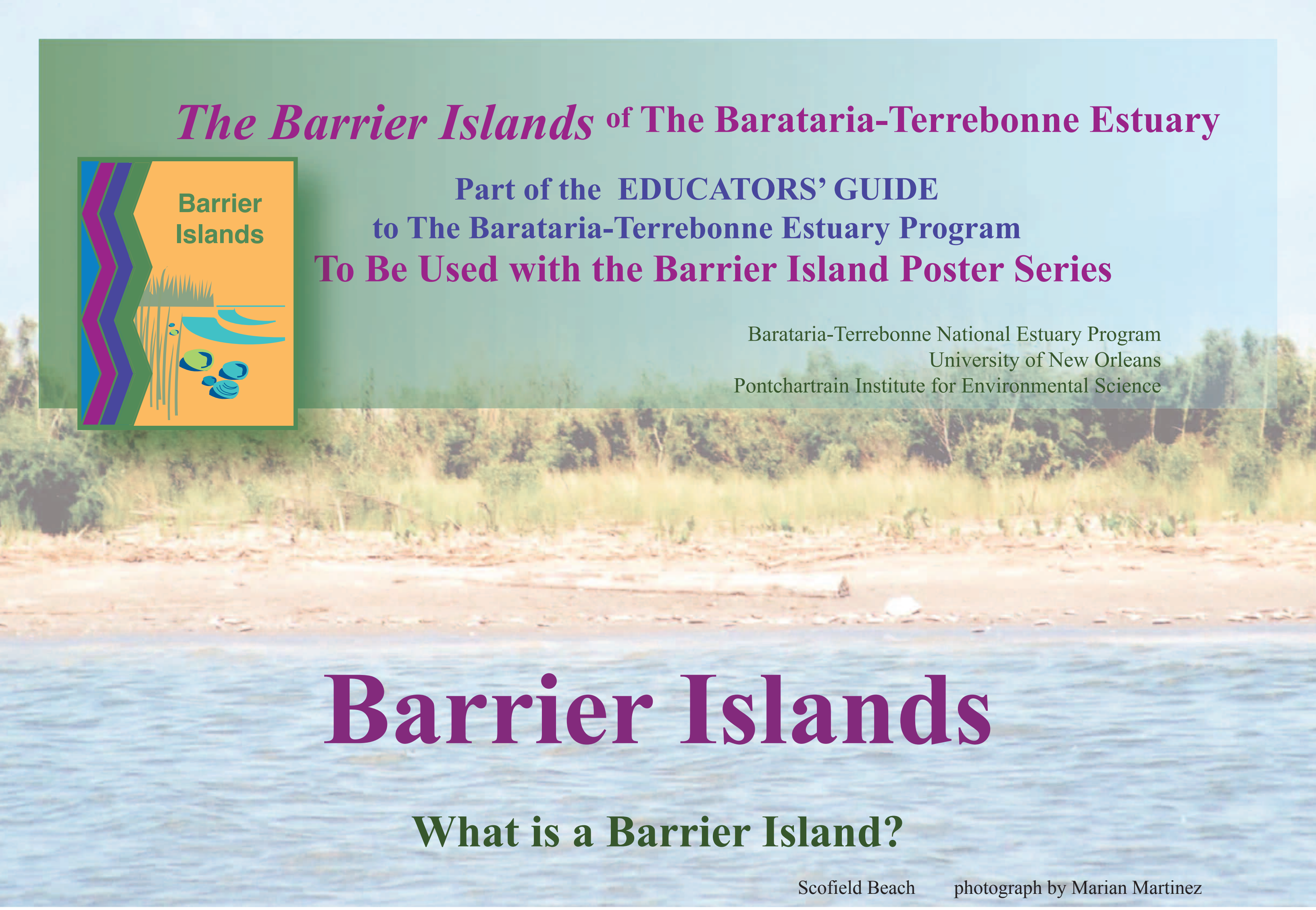
Recent publications that Dinah Maygarden has authored or contributed to include:
Maygarden, D., Egger, H., *Coastal Restoration Projects in the Lake Pontchartrain Basin*, Multi-media materials, 2007, Pontchartrain Institute for Environmental Sciences.
Banbury, M.M., Rheams, A.B., Lyons, S. E. *Spirit of the Estuary: Using Art to Understand Ecology*, 2007, Barataria-Terrebonne National Estuary Program. Contributed two chapters.
Blanchard, P.B., (Ed)., *Educators Guide to the Barataria-Terrebonne Estuary, Barataria-Terrebonne National Estuary Program*, 2006, Major contributor.
Maygarden, D.F., Knapp, B., Briuglio, S., Rheams, A.B., *A Guide to the Wetlands of the Lake Pontchartrain Basin Wetlands*, 2004, Second Edition.

GRAPHIC DESIGN

The graphic design for this publication has been provided by Marian Brister Martinez. Ms. Martinez is a Louisiana artist/illustrator with roots in coastal Louisiana. She has designed publications for wetland awareness programs such as *Spirit of the Estuary: Using Art to Understand Ecology, Claude and Clawdette's Estuary Adventure* and *Louisiana Estuary Cuisine with Chef Brandon LeBlanc.* She is also published in *Louisiana Laurels*, a book of poetry and essays written and illustrated by Louisiana authors and artists. She has created numerous t-shirt designs and logos for environmental litter awareness programs for corporate and non-profit companies. In 2007, as a part of the *Spirit of the Estuary* team, she was a recipient of the *Coastal Stewardship Award* for her part of graphic design and illustration, an award given by the Coalition to Restore Coastal Louisiana..

Ms. Martinez's fine art work encompasses a variety of mediums and subject matter including architectural drawings, oil on canvas figurative and landscape paintings, watercolors, commentary on the human condition and traditional religious iconography. Her work can be viewed on her website at http://www.pleiadesfineart.com.

Special thanks to Susan Testeroet-Bergeron and Alma Robichaux for their dedicated work on this project.



The Barrier Islands of The Barataria-Terrebonne Estuary

Part of the EDUCATORS' GUIDE
to The Barataria-Terrebonne Estuary Program
To Be Used with the Barrier Island Poster Series

Barataria-Terrebonne National Estuary Program
University of New Orleans
Pontchartrain Institute for Environmental Science

Barrier Islands

What is a Barrier Island?

Scofield Beach photograph by Marian Martinez

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.

Louisiana Barrier Islands

Scofield Beach arial view   photograph by 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.

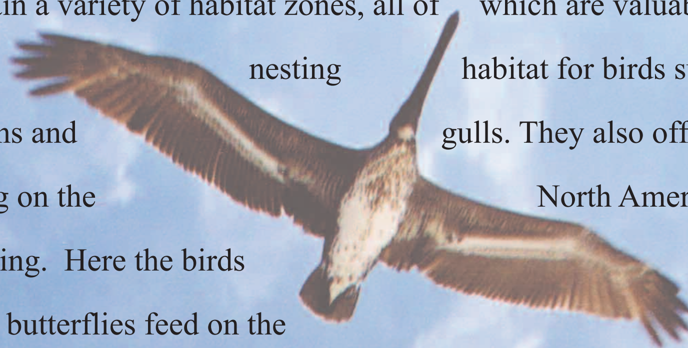
The Importance of Barrier Islands

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 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.



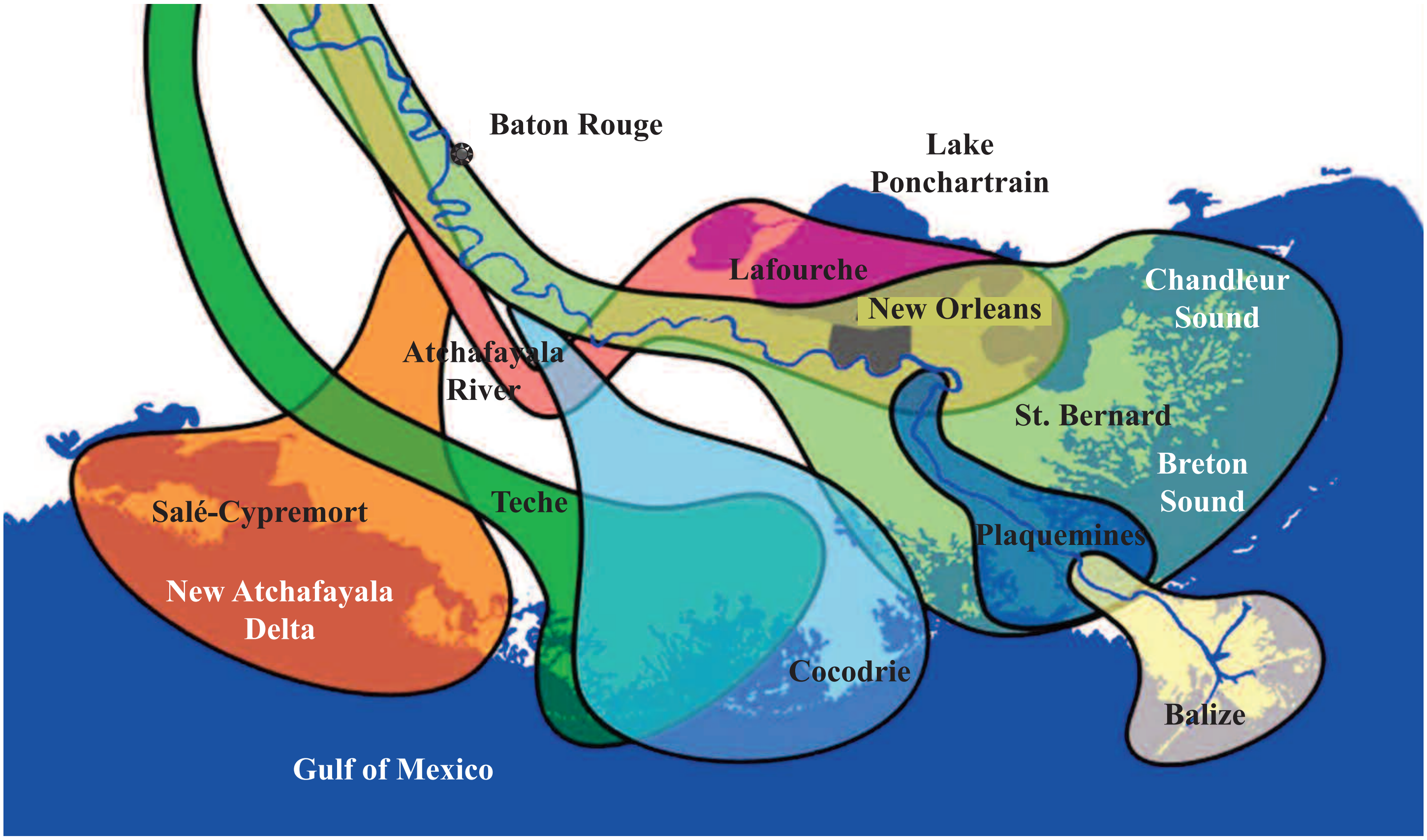
photograph by Marian Martinez

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.

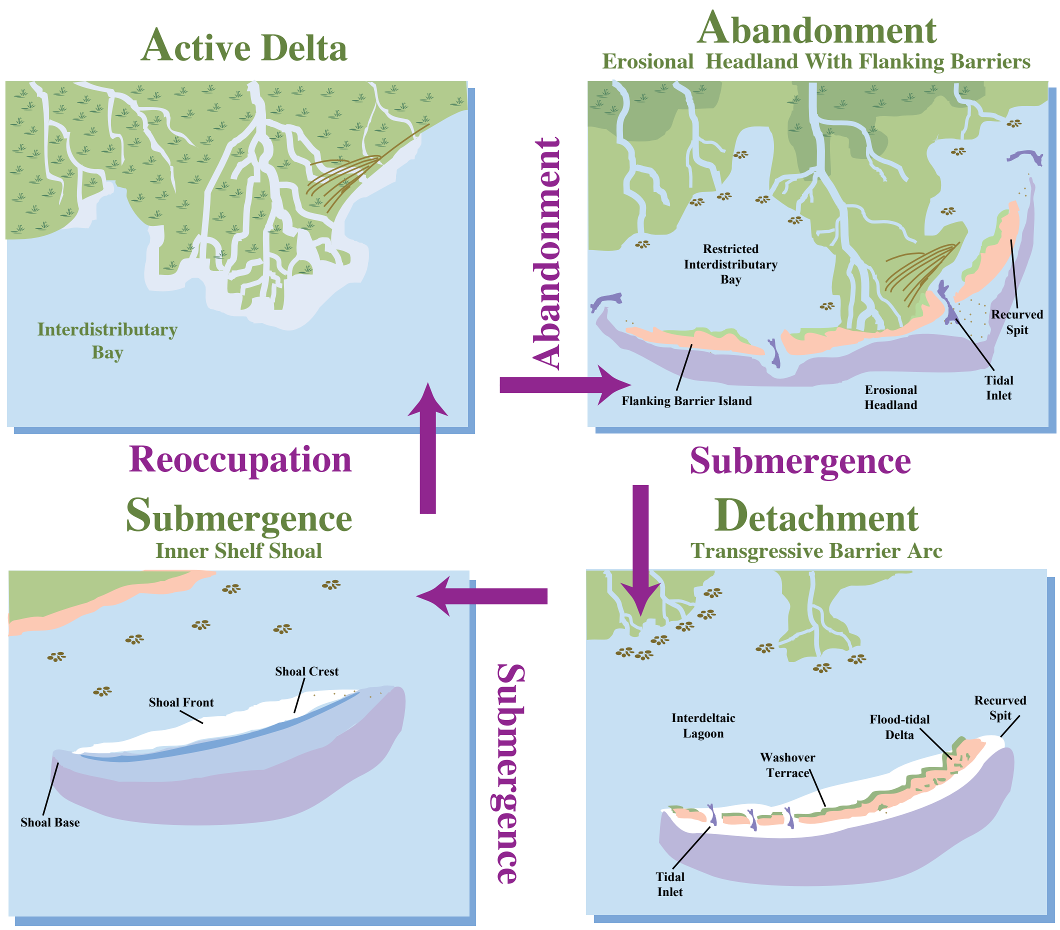


Kolb,van Lopik (1958). Geology of the Mississippi River deltaic plain, southeastern Louisiana. Technical Report 3-483. Vicksburg, MS: U.S. Army Corps of Engineers Waterways Experiment Station
Kulp, M. A., Howell, P., Adiau, S., Penland, S., Kindinger, J., and Williams, S. J., 2002, Latest Quaternery 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 building 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 sea level 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.

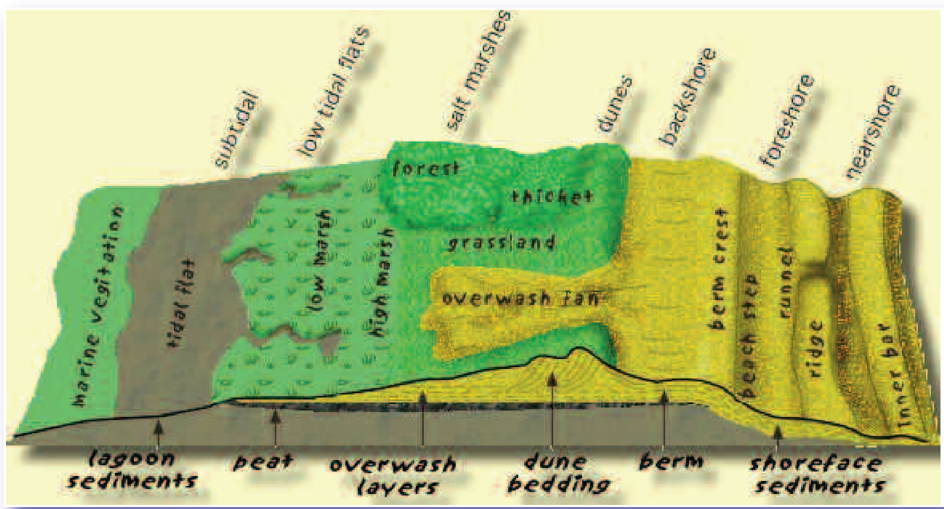
The Status of Louisiana's Barrier Islands Today

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 near 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

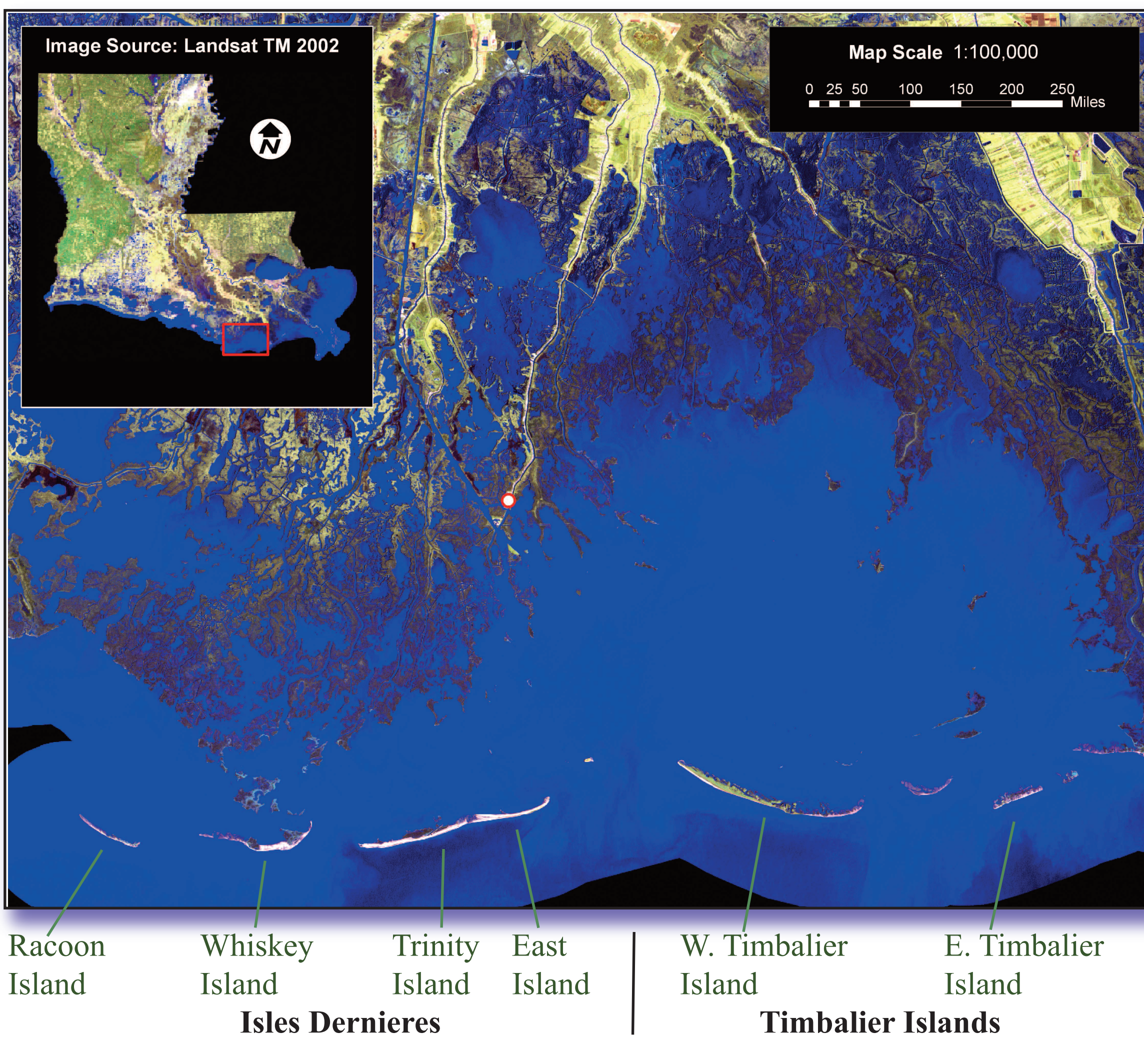
Below is a cross section of a "typical" barrier island. Barrier islands vary greatly, but a typical island off the coast of Louisiana would have the following features: Beginning at the shoreline of the Gulf of Mexico, the beach rises gently in elevation. The sand is fine-grained and tan in color. Shells 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. 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.



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

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.

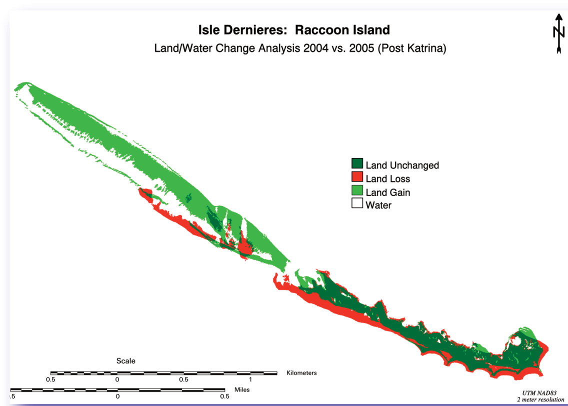


The Isles Dernieres

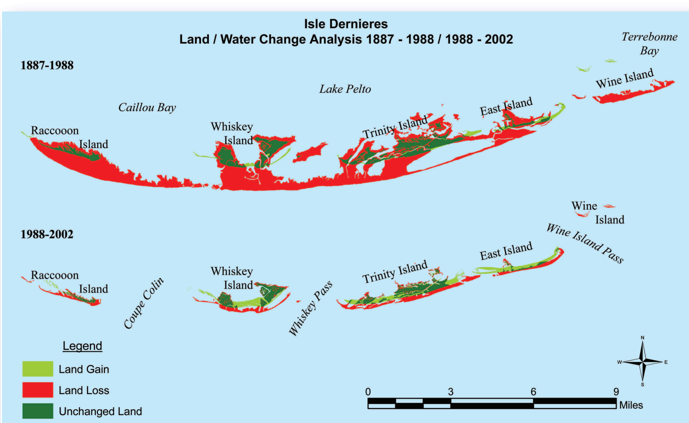
The Isles Dernieres are today made up of either three, four or five islands, depending on your perspective! The complete set of five from west to east are: Raccoon, Whiskey, Trinity, East and Wine Islands. Wine Island was restored with rocks and dredged material after it became a shoal. Today, there 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.

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

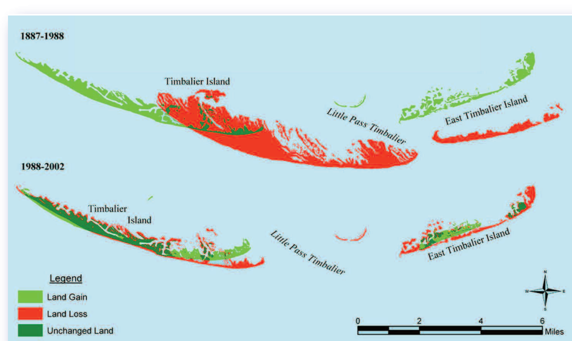
In the 1850's, Isles Dernieres was a single island barely detached from the mainland. In those days people farmed, grazed cattle and lived and vacationed on the island. There was an overland route used to drive cattle to and from the island. In 1856, a catastrophic hurricane caused a storm surge to wash 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.



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

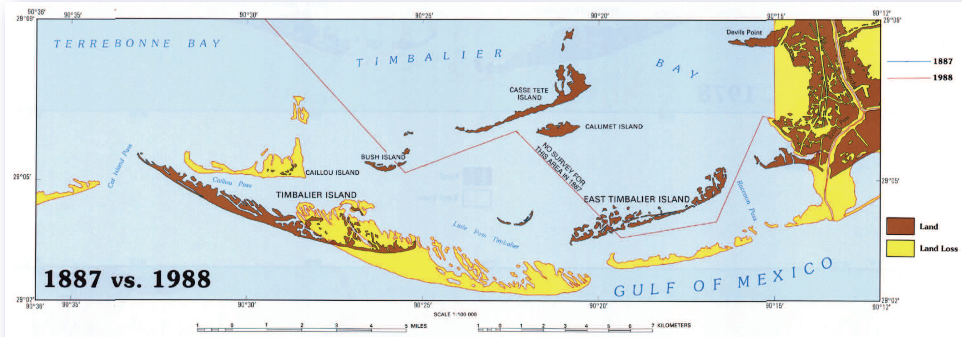


Shoreline change analysis maps of Isles Dernieres. Top: change between 1887 and 1988. Bottom: change between 1988 and 2002. Map Courtesy of UNO Pontchartrain Institute for Environmental Sciences.



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.

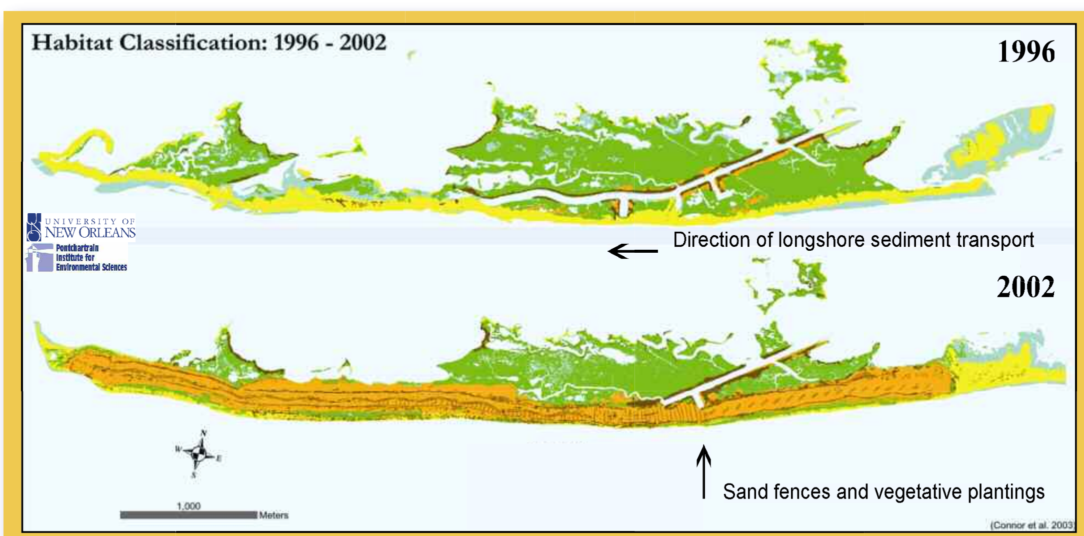
Grand Isle

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.

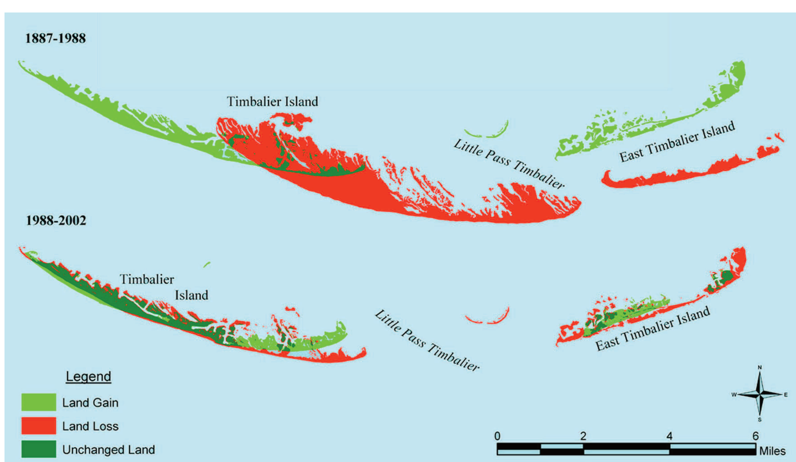


Sediment restoration on Trinity Island. Map Courtesy of UNO Pontchartrain Institute for Environmental Sciences.

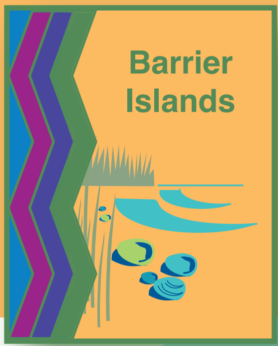
Barrier Island Restoration in The Barataria-Terrebonne Estuary

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.

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



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



Map It

Activity 1-1

Focus/ Overview

In this activity the students will learn about the dynamics of Louisiana's barrier islands by analyzing maps that show the changes in land area over time.

Learning Objectives

The Students will . . .

- Use maps and figures showing rates of land loss and gain in the Isles Dernieres to examine and interpret the changes that have taken place in the islands over time.
- Discover through guided questions that the islands move in a predominantly landward direction and also gradually lose area.
- Analyze the reasons for the observed changes and predict what will happen in the future using information from the maps.

Materials List

- Posters of the Barrier Islands of Barataria Terrebonne Estuary
- Figure 1: Shoreline Change Analysis maps of Isles Dernieres (1887 – 1988 and 1988 – 2002)
- Figure 2: Raccoon Island Shoreline Changes 2004 vs. 2005
- Figure 3: Shoreline Change Analyis Maps of Timbalier Islands
- 1/4 inch scale squared graph paper transferred onto transparency sheets using a copy machine or printer (See Blackline Master 1)
- Rulers (preferably with both inches and centimeters)

Background Information

Read the background information on the "five steps of barrier island formation" (Page 5) and the description of the Barrier Islands of Barataria-Terrebonne – Isles Dernieres and Timbalier Islands (Pages 8 - 12). A great deal can be learned from maps about the changes due to erosion

BTNEP Connection
Habitats

Grade Level
5-8, Environmental Science

Duration
1 Hour

Subject Area
Science

Setting
Classroom

Extension Areas
Barrier Island field trip

Vocabulary
Coastal Restoration
Barrier Islands
Coastal Erosion
Delta cycle
Land loss
Rates of erosion
Geographic information Systems (GIS)
Shoreline change analysis
Scale bar
Sediment movement
Land formation

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taking place in coastal Louisiana. By looking at historical maps dating back to the 19th Century, and using Geographic Information Systems (GIS) to overlay more recent maps, the dramatic changes that have taken place over time become very clear. This method is used by scientists to calculate rates of land loss over time. The two chains of islands off the coast of Terrebonne Parish, The Isles Dernieres and the Timbalier Islands, have undergone rapid erosion while at the same time migrating due to sediment movement. In this activity you will measure the erosion and analyze how the islands have changed and moved over time.

Advance Preparation

- Make enough color copies of the maps (Figures 1, 2 and 3) for the students to work in small groups of 3-4.
- Make the same number transparency copies of graph paper.

Procedure: Map Interpretation

with Teacher's Guide to Blackline Master 2

Using Figure 1:

1. Look carefully at Figure 1: Isles Dernieres 1887 – 1988. Note the scale bar and north arrow. How many years of change are represented on this map? **101 years**

2. Look at the scale bar. How many miles are represented by 1 inch on the map? **1" = 3 miles**

3. What color(s) represents land in 1887? **red**

4. What color(s) represents land in 1988? **dark green**

5. Using the scale bar and a ruler, estimate the distance from the western tip of Raccoon Island to the eastern tip of Wine Island in 1887. **15 miles**

6. How many islands made up Isles Dernieres in 1887? **3**

7, How many islands were there in the chain in 1988? **6**

8. Focus on Raccoon Island. Describe how Raccoon Island changed between 1887 and 1988. **It is smaller and closer to the land or moving from the Gulf of Mexico to the north.**

9. Describe how Wine Island changed between 1887 and 1988. **It is gone.**

10. Look at the bottom map on Figure 1 showing Isles Dernieres between 1988 and 2002. How many years are represented here? **14 years.**

11. Using the scale bar and a ruler, estimate the distance from the western tip of Raccoon Island to the eastern tip of Wine Island in 1988. **18 miles**

12. Describe the changes to Raccoon Island in this time period. **The seaward side of the island has eroded away and the western side of the island is gone.**

13. Describe the changes to Wine Island during this time period. **It is completely lost.**

14. Do you think there is a trend or pattern seen in the changes that have taken place? **Yes, islands are being lost; moving north and lost to the west.**

15. Look at Figure 2: *Raccoon Island 2004-2005*. What has happened to this island recently? **It has been rebuilt with sediment pumped from offshore sources.**

16. Predict what the maps may look like in 2050. What do you think are the causes for this predicted change? **Answers will vary.**

17. If the islands are no longer visible above water in 2050, where will the sand be? **The sand is underwater. This area is now called a shoal. For example, Ship Shoal is a former barrier island that is now used as a sand source for coastal restoration.**

18. What effects could the disappearance of the islands have in coastal communities such as Cocodrie and Houma (locate these towns on a map of Louisiana)? **Answers will vary.**

19. Using Figure 3 *Timbalier Island*, measuring land area change over time:

a. Use the piece of squared transparency graph paper provided to calculate how many square inches the island covered at each time period on the map. Estimate the area in square inches of each of the three colored areas representing unchanged land (dark green), land loss (red), and land gained (light green). **Note:** The land area in 1887 is actually the unchanged land (dark green) + land loss (red). In order to make your estimates, you may want to begin by counting the completely filled squares for one time period (color). Make a note of the number; then look for the half-filled squares and total them; then do the quarter filled squares. Keep a tally and then when you are finished, total everything up and write the number of squares on the Results Table below.

b. Using the scale bar, calculate the actual area of the island that number of squares represents and complete the Results Table below.

Note: When several groups of students work through this exercise, they will arrive at a range of numbers. There is no "right or wrong".

c. As a class, look at each group's results and complete a master chart on the class board. This may involve taking the mean of the range of numbers. It may also mean first discarding those numbers that vary too much from the majority. Discuss these ideas with the class.

d. After the first three columns of the chart are complete find the area change by subtracting the land area in 1988 from that in 1887, then 2002 from 1988. To find the area percent change for each time period divide the area change (T1 – T2) by the time 1 area (T1) and multiply by100 (T1 - T2/ T1 X100). When the chart is complete, estimate the answers to the following questions:

1. Approximately what percentage of the island was lost between 1887 and 1988?
2. Approximately what percentage has been gained?
3. Approximately what percentage of land remained the same?
4. What caused the areas of land gain?
5. Calculate the ANNUAL rate of loss (hint – take the total loss and divide by the number of years between the two dates)

Repeat the above steps for the maps in Figure 2 showing change between 1887 and 1988, and 1988 and 2002.

Results Table

	Total Number of Squares on grid	Area in Square Miles	Area in Square Kilometers (km^2)	Area Change		% Change = T1 - T2 ________X 100 T1
				$miles^2$	km^2	
Area Isles Dernieres 1887 (red + dark green)						
Area Isles Dernieres 1988 (dark green + light green top map, or red bottom map)						
Area Isles Dernieres 2002 (dark green + light green bottom map)						
Area Timbalier Islands 1887 (red + dark green)						
Area Timbalier Islands 1988 (dark green + light green)						
Area Timbalier Islands 2002 (dark green + light green, bottom map)						

Answers will vary.

Assessment

Assess the students' ability to measure accurately, complete the results table correctly and accurately within the general margin of error, and to interpret the maps and make predictions and inferences based on their observations.

Blackline Masters

Blackline Master 1: Mapt It: Grid

Blackline Master 2: Map It: Changes and Movement of Islands

Extension

Arrange a field trip to a barrier island so students can see first-hand evidence of barrier island erosion. Field trips to the Isles Dernieres and Timbalier Islands require boats. Louisiana Universities Marine Consortium conducts boat trips in this area. Visit www.lumcon.edu. A trip to Grand Isle can be done easily by road to study the general features of barrier islands.

Blackline Master 1

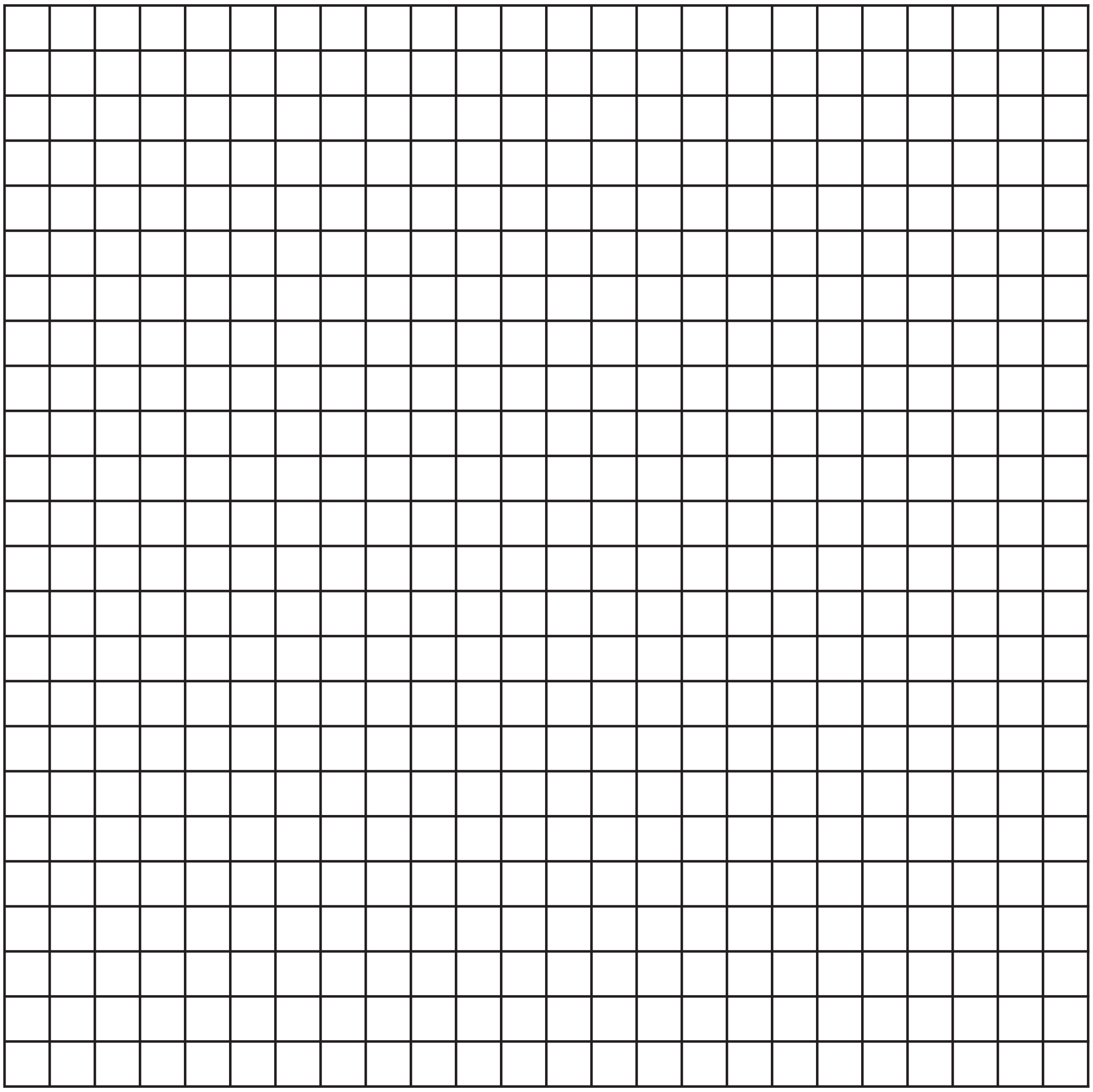
Map It Grid

Activity 1-1

Student Name: ____________________

Map It

Instructions: **Use this transparency to calculate the area of a barrier island.**



1/4" scale

Blackline Master 2

Map It: Changes and Movement of Islands

Activity 1-1

Using Figure 1:

1. Look carefully at Figure 1: Isles Dernieres 1887 – 1988. Note the scale bar and north arrow. How many years of change are represented on this map? ____________________

2. Look at the scale bar. How many miles are represented by 1 inch on the map? ____________________

3. What color(s) represents land in 1887? ____________________

4. What color(s) represents land in 1988? ____________________

5. Using the scale bar and a ruler, estimate the distance from the western tip of Raccoon Island to the eastern tip of Wine Island in 1887. ____________________

6. How many islands made up Isles Dernieres in 1887? ____________________

7. How many islands were there in the chain in 1988? ____________________

8. Focus on Raccoon Island. Describe how Raccoon Island changed tetween 1887 and 1988.

____

____

9. Describe how Wine Island changed between 1887 and 1988.

____

____

10. Look at the bottom map on Figure 1 showing Isles Dernieres between 1988 and 2002. How many years are represented here? ____________________

11. Using the scale bar and a ruler, estimate the distance from the western tip of Raccoon Island to the eastern tip of Wine Island in 1988. ____________________

12. Describe the changes to Raccoon Island in this time period. ____________________

____

____

13. Describe the changes to Wine Island during this time period. ____________________

____

____

Blackline Master 2

Map It: Changes and Movement of Islands

Continued   page 2   Activity 1-1

14. Do you think there is a trend or pattern seen in the changes that have taken place? Describe.

15. Look at Figure 2: Raccoon Island 2004-2005. What has happened to this island recently?

16. Predict what the maps may look like in 2050. What do you think are the causes for this predicted change?

17. If the islands are no longer visible above water in 2050, where will the sand be?

18. What effects could the disappearance of the islands have in coastal communities such as Cocodrie and Houma (locate these towns on a map of Louisiana)?

19. Using Figure 3: Timbalier Island, measuring land area change over time:
    a. Use the piece of squared transparency graph paper provided to calculate how many square inches the island covered at each time period on the map. Estimate the area in square inches of each of the three colored areas representing unchanged land (dark green), land loss (red), and land gained (light green).
    Note: The land area in 1887 is actually the unchanged land (dark green) + land loss (red). In order to make your estimates, you may want to begin by counting the completely filled squares for one time period (color). Make a note of the number; then look for the half-filled squares and total them; then do the quarter filled squares. Keep a tally and then when you are finished, total everything up and write the number of squares on the Results Table below.

    b. Using the scale bar, calculate the actual area of the island that number of squares represents and complete the Results Table below.
    Note: When several groups of students work through this exercise, they will arrive at a range of numbers. There is no “right or wrong”

Blackline Master 2

Map It: Changes and Movement of Islands

Continued page 3 **Activity 1-1**

c. As a class, look at each group's results and complete a master chart on the class board. This may involve taking the mean of the range of numbers. It may also mean first discarding those numbers that vary too much from the majority. Discuss these ideas with the class.

d. After the first three columns of the chart are complete find the area change by subtracting the land area in 1988 from that in 1887, then 2002 from 1988. To find the area percent change for each time period divide the area change (T1 – T2) by the time 1 area (T1) and multiply by 100 (T1 - T2/ T1 X100). When the chart is complete, estimate the answers to the following questions:
i. Approximately what percent of the island was lost between 1887 and 1988?
ii. Approximately what percent has been gained?
iii. Approximately what percent of land remained the same?
iv. What caused the areas of land gain?
v. Calculate the ANNUAL rate of loss (hint – take the total loss and divide by the number of years between the two dates)

e. Repeat the above steps for the maps in Figure 2 showing changes on Isle Dernieres between 1887 and 1988, and 1988 and 2002.

Results Table

	Total Number of Squares on grid	Area in Square Miles	Area in Square Kilometers (km^2)	Area Change $miles^2$	km^2	% Change = $\frac{T1 - T2}{T1}$ X 100
Area Isles Dernieres 1887 (red + dark green)						
Area Isles Dernieres 1988 (dark green + light green top map, or red bottom map)						
Area Isles Dernieres 2002 (dark green + light green bottom map)						
Area Timbalier Islands 1887 (red + dark green)						
Area Timbalier Islands 1988 (dark green + light green)						
Area Timbalier Islands 2002 (dark green + light green, bottom map)						

Figure 1: Shoreline Change Analysis Maps of Isle Derneires
1887-1988 (top) and 1988-2002 (bottom)

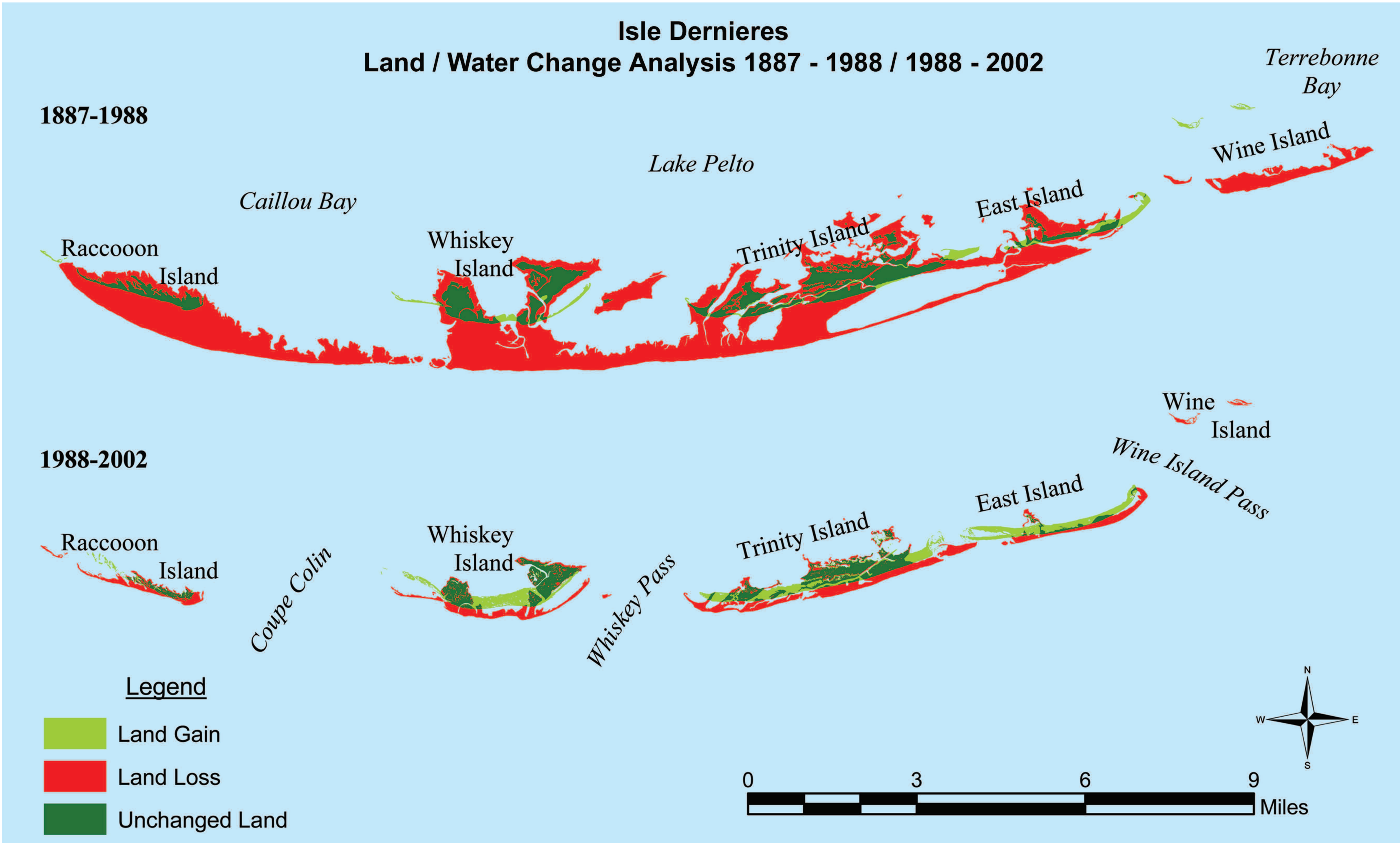


Figure 2: Isle Dernieres: Raccoon Island
Shoreline Changes 2004 vs. 2005 (Post Katrina)

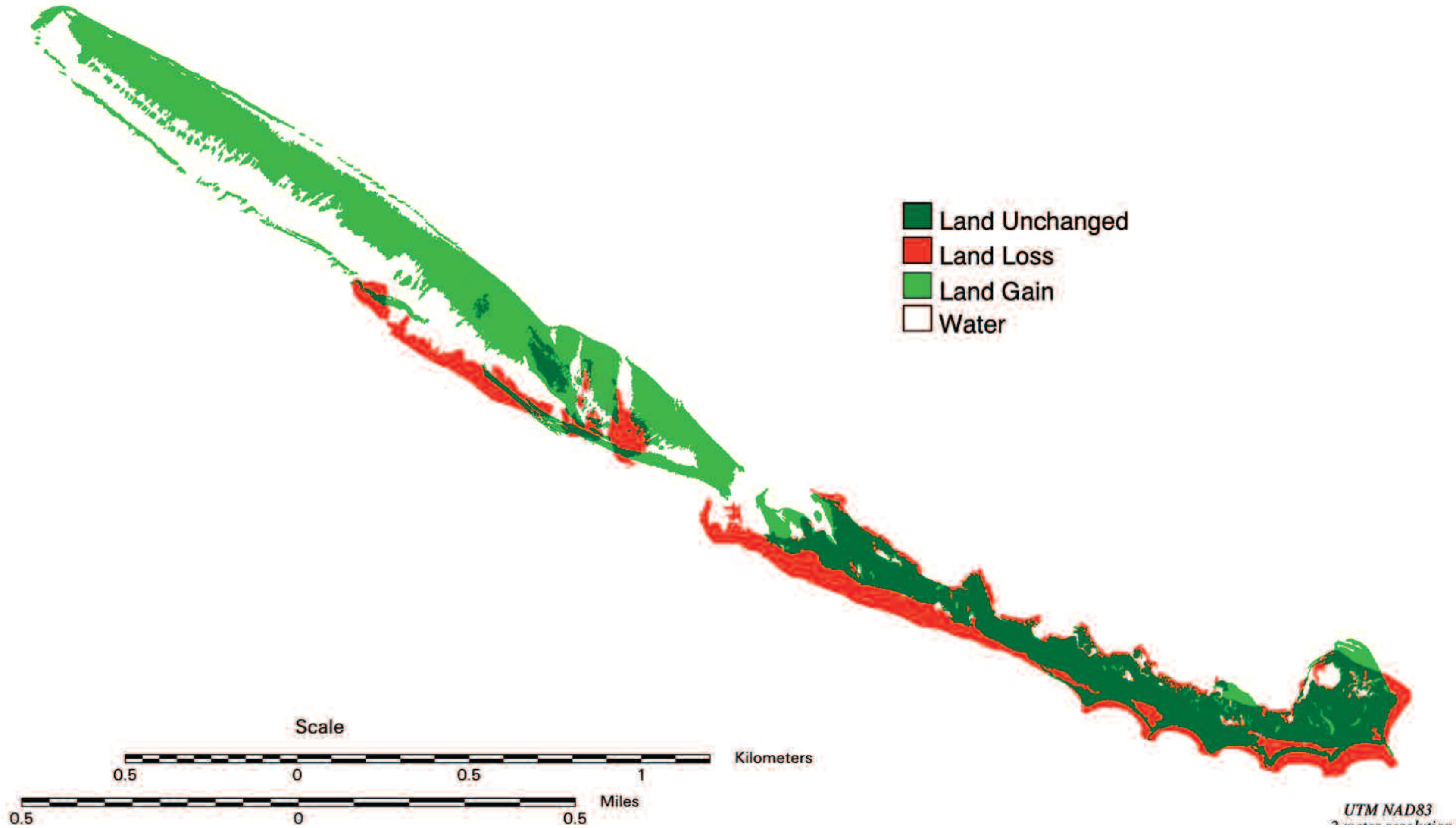
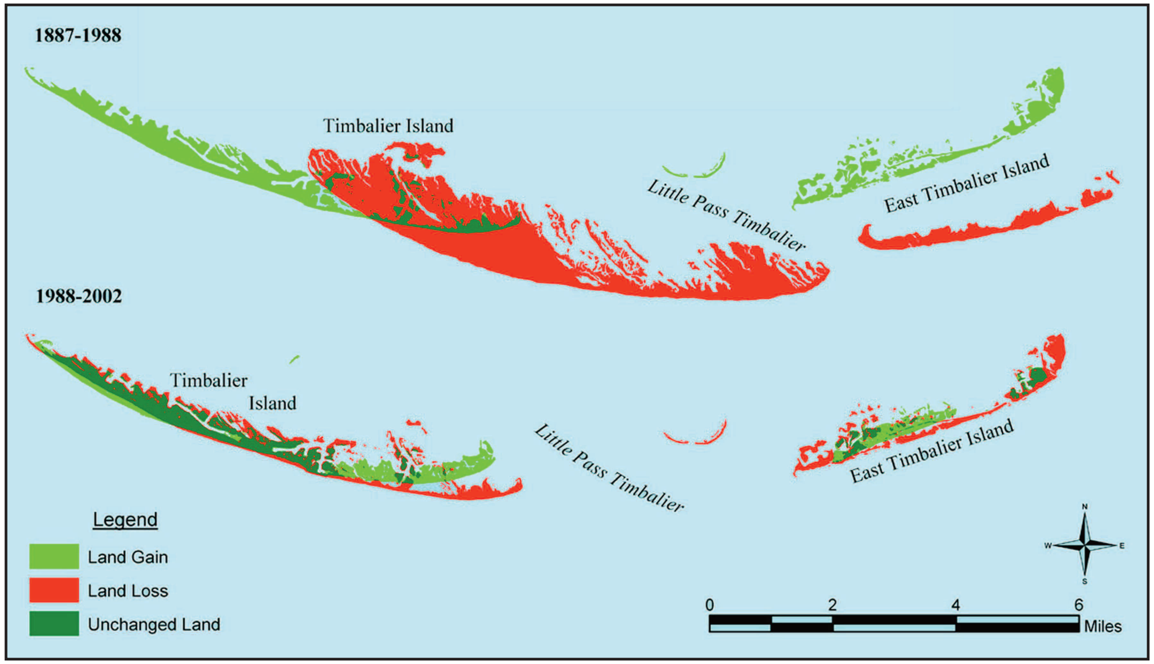


Figure 3: Shoreline Change Analysis Maps of the Timbalier Islands
1887 – 1988 and 1988 - 2002



Grade Level Expectations

Lesson One: Map It

Lesson One: Map It — Math

Measurement

3: GLE - 19	Measure length to the nearest meter and half-inch	M-1-E	
3: GLE - 23	Find the area in square units of a given rectangle (including squares) drawn on a grid or by covering the region with square tiles	M-1-E	
3: GLE - 25	Select and use the appropriate standard units of measure, abbreviations, and tools to measure length and perimeter (i.e., in. cm, ft., yd., m,), area (square inch, square centimeter), capacity (i.e., cup, pint, quart, allon, liter), and weight/mass (i.e., oz., lb., g, kg, ton)	M-2-E	
3: GLE - 27	Compare U.S. and metric measurements using approximate reference points without using conversions (e.g., a meter is longer than a yard)	M-3-E	M-4-E
3: GLE - 28	Estimate length, weight/mass, and capacity	M-3-E	
4: GLE - 20	Measure length to the nearest quarter-inch and mm	M-2-E	M-1-E
4: GLE - 24	Recognize the attributes to be measured in a real-life situation	M-2-E	M-5-E
4: GLE - 26	Estimate the area of an irregular shape drawn on a unit grid	M-3-E	
5: GLE - 23	Identify and select appropriate units to measure area	M-3-M	
6: GLE - 22	Estimate perimeter and area of any 2-dimensional figure (regular and irregular) using standard units	M-2-M	
6: GLE - 23	Identify and select appropriate units to measure area	M-3-M	

Measurement cont.

7: GLE - 20	Determine the perimeter and area of composite plane figures by subdivision and area addition	M-1-M	G-7-M
7: GLE - 21	Compare and order measurements within and between the U.S. and metric systems in terms of common reference points (e.g., weight/mass and area)		M-4-M G-1-M
8: GLE - 19	Demonstrate an intuitive sense of the relative sizes of common units of volume in relation to real-life applications and use this sense when estimating	M-2-M	G-1-M
9: GLE - 21	Determine appropriate units and scales to use when solving measurement problems	M-2-H	M-3-H M-1-H

Number and Number Relations

8: GLE - 8	Solve real-life problems involving percentages, including percentages less than(<) 1 or greater than (>) 100	N-8-M	N-5-M

Data Analysis, Probability, and Discrete Math

3: GLE - 41	Explain the word average and use it appropriately in discussing what is "typical" of a data set	D-1-E
3: GLE - 43	Represent and solve problems using data from a variety of sources (e.g., tables, graphs, maps, advertisements)	D-3-E

Lesson One: Map It Science

Science as Inquiry The Abilities To Do Scientific Inquiry

3: GLE - 7	Measure and record length, temperature, mass, volume, and area in both metric system and U.S. system units	SI-E-A4

Science as Inquiry The Abilities To Do Scientific Inquiry cont.

3: GLE -10	Combine information, data, and knowledge from one or more of the science content areas to reach a conclusion or make a prediction	SI-E-A5
4: GLE -1	Ask questions about objects and events in the environment (e.g., plants, rocks, storms)	SI-E-A1
4: GLE -2	Pose questions that can be answered by using students' own observations, scientific knowledge, and testable scientific investigations	SI-E-A1
4: GLE -8	Measure and record length, temperature, mass, volume, and areas in both metric system and U.S. system units	SI-E-A4
4: GLE -11	Combine information, data, and knowledge from one or more of the science content areas to reach a conclusion or make a prediction	SI-E-A5
5-8: GLE -13	Identify patterns in data to explain natural events	SI-M-A4
5-8: GLE -16	Use evidence to make inferences and predict trends	SI-M-A5
5: GLE -17	Recognize that there may be more than one way to interpret a given set of data, which can result in alternative scientific explanations and predictions	SI-M-A6
5-8: GLE -21	Distinguish between *observatons* and *inferences*	SI-M-A7

Science as Inquiry Understanding Scientific Inquiry

3, 4: GLE -13	Identify questions that need to be explained through further inquiry	SI-E-B1
5: GLE -31	Recognize that there is an acceptable range of variation in collected data	SI-M-B3
5: GLE -32	Explain the use of statistical methods to confirm the significance of data (e.g., mean, median, mode, range)	SI-M-B3
5: GLE -38	Explain that, through the use of scientific processes and knowledge, people can solve problems, make decisions, and form new ideas	SI-M-B6
5: GLE -39	Identify areas in which technology has changed human lives (e.g., transporation, communication, geographic information systems, DNA fingerprinting)	SI-M-B7
5: GLE -40	Evaluate the impact of research on scientific thought, society, and the environment	SI-M-B7

Earth and Space Science Properties of Earth Materials

4: GLE -63	Demonstrate and explain how Earth's surface is changed as a result of slow and rapid processes (e.g., sand dunes, canyons, volcanoes, earthquakes)	ESS-E-A5 ESS-E-A1

Earth and Space Science Structure of the Earth

5: GLE -32	Demonstrate the results of constructive and destructive forces using models or illustrations	ESS-M-A7
5: GLE -33	Identify the processes that prevent or cause erosion	ESS-M-A7
8: GLE -19	Determine the results of constructive and destructive forces upon landform development with the aid of geologic maps of Louisiana	ESS-M-A7
8: GLE -20	Describe how humans' actions and natural processes have modified coastal regions in Louisiana and other locations	ESS-M-A8
8: GLE -21	Read and interpret topographic maps	ESS-M-A9

Earth History

5: GLE -38	Estimate the range of time over which natural events occur (e.g., lightning in seconds, mountain formation over millions of years)	ESS-M-B3

Earth and Space Science The Origin and Evolution of the Earth System

9,10,11,12: GLE -19	Interpret geological maps of Louisiana to describe the state's geologic history	ESS-H-C3
9,10,11,12: GLE -20	Determine the chronological order of the five most recent major lobes of the Mississippi River delta in Louisiana	ESS-H-C3
9,10,11,12: GLE -22	Analyze data related to a variety of natural processes to determine the time frame of the changes involved (e.g., formation of sedimentary rock layers, deposition of ash layers, fossilization of plant or animal species)	ESS-H-C5

Barrier Islands

Keeping Our Heads Above Water

Success of Restoration Projects Activity 2

Focus/ Overview

In this lesson, students will use maps and graphed data created by coastal scientists, as well as online information on coastal restoration projects, to analyze changes in land area that have taken place on Louisiana's barrier islands. They will use critical thinking skills to evaluate a restoration project on a barrier island in terms of costs and benefits. They will make predictions about future land area changes on the barrier islands.

Learning Objectives

The Students will . . .

- Analyze maps and graphed data showing a barrier island before and after restoration and before and after Hurricanes Katrina and Rita.
- Evaluate the success of the restoration project using the data and by collecting online information.
- Predict the future changes in land area in the barrier islands.

Materials List

- Computer with internet access
- Blackline Masters 1, 2, and 3 (one per student or student group)
- Copy of BTNEP resources

  Posters of *The Barrier Islands of the Barataria-Terrebonne Estuary*

Background Information

The Isles Dernieres barrier Islands (made up of Raccoon, Whiskey Trinity, and East Islands), have been eroding for many years and in 1989, scientists made the following prediction: "The Isles Dernieres now lie several miles seaward of the retreating mainland, and at current rates, they will be destroyed by 2007" (McBride and others, 1989, in

BTNEP Connection
Habitats

Grade Level
5-8, Environmental Science

Duration
1 Hour

Subject Area
Science

Setting
Classroom

Extension Areas
Barrier Island field trip

Vocabulary
Coastal Restoration
Barrier Islands
Cost-benefit assessment
CWPPRA
Coastal erosion
Habitat change
Storm surge
Sediment deposition
Sediment transport

UNIVERSITY OF NEW ORLEANS

Pontchartrain Institute for Environmental Sciences
University of New Orleans

Louisiana Barrier Island Erosion Study: Atlas of Shoreline Changes). Although it may seem that they were mistaken, the islands are above water today because projects were designed and implemented that increased their width and height by pumping sediment onto them. Figure 1 on Blackline Master #2 illustrates an example of one of these projects. In all, Raccoon, Whiskey, Trinity, and East Islands in the Isles Dernieres chain and Timbalier and West Timbalier Islands have all been restored in this way. These projects have proved successful in helping to maintain the barrier islands in the face of numerous storms. In this activity we will take a close look at these projects and analyze their costs and benefits to decide just how successful they really are.

Advanced Preparation

1. Make enough copies of Blackline Masters 1, 2 and 3 for the students to work individually or in small groups.

Procedure: Analyze, Assess, Predict

with Teacher's Guide to Blackline Master

Using figure 1:

1. Study Figure 1 on Blackline Master 2. It is a map of Trinity Island before and after restoration done by CWPPRA, the Coastal Wetlands Planning, Protection and Restoration Act. List three differences you observe between the first and second map.

Answers will vary but may include: canals are filling in, there is more bare land, island is wider on the east.

2. Go to the website http://www.lacoast.gov and click on the "projects" tab at the top of the page. An interactive map will come up. You can mouse over this map to find any project (in this case TE 24 on Trinity Island off the coast of Terrebonne Parish.) An active link will appear and you can navigate to the project Fact Sheet. An alternate way to navigate to a project is to use the alphabetic list of all the projects

in the state, via the link found below the map. In order to use the list to find the barrier Islands in the Barataria Terrebonne estuary, search for projects in Terrebonne Parish (beginning with "TE") and then scroll down to Isles Dernieres Restoration Trinity Island (TE-24) and click on that project.
Find TE-24 General Project Fact Sheet and open it up. (Or print the fact sheets supplied at the end of this lesson.) Use this source of information to find the answers to the following questions:

a. In what year was the project completed? 1999

b. What was the size of the project area in acres? 776 acres

How many acres of land were created by the project (not the same number)? 500 acres

How many acres are projected to remain after 20 years? 109 acres

c. Why will the area decrease over 20 years? Answers will vary but may include causes for erosion or land loss such as hurricanes, wave action, winter storms, or human degradation.

d. How much did the project cost? $10.7 million How much per acre is this (cost of project divided by the number of acres created)? For 500 acres the cost is $21,400 per acre but for 109 acres the cost is $98,165 per acre. How was this project funded? Through federal and state funds in a project called the Coastal Wetlands Planning Protection and Restoration Act.

e. What is the main benefit of the project? Creation of a new marsh platform that will protect the island and the land behind it.

Using figure 2:

3. Use Figure 2 to answer the following questions about the effects of the 2005 hurricanes on Trinity Island.

   a. What was the main impact of the hurricanes to Trinity and East Islands? It removed sediment from the island. Which of the two islands lost more land area? East Island

   b. Before August/ September 2005, Trinity and East Islands were separate. What caused them to join? Hurricanes moved the sediment.

   c. Based on the information available, do you think the restoration projects on Trinity and East Islands helped to prevent erosion during hurricanes Katrina and Rita? Answers will vary.

d. Do you think the restoration project was successful in its goal to prevent the disappearance of the islands? Answers will vary but the project managers were pleased with the results.

Using figure 3:

4. Use Figure 3 to answer these questions about Trinity Island's change over time.

   a. What was the land area of Trinity Island in 1978? 1,300 acres

   b. What was the land area after Hurricane Andrew in 1992? 680 acres

   c. What was the land area in 2002? 750 acres

   d. Calculate the change in area between 1978 and 1992 and between 1992 and 2002.

      1978 to 1992 1,300 acres - 680 acres = 620 acres lost

      1992 to 2002 620 acres to an increase of 750 acres = 70 acres gained

   e. Do these figures indicate that the restoration project helped to increase the land area of the islands? yes

   f. Draw a line on the graph to predict the land area change caused by Hurricanes Katrina and Rita (use Figure 2 to help you predict). Slightly down

   g. Based on the information in the graph, write a prediction for the land area change for Trinity Island for the time period 2002 – 2020. What known and unknown factors must be taken into account to make such a prediction?

   Land will probably be lost due to hurricanes and winter storms.

   h.What do you think your children will learn about Louisiana's barrier islands when they are your age? Answers will vary.

5. Based on your answers above and the knowledge you have about the values of barrier islands to Louisiana's coastal residents, complete the cost/ benefit table for TE 24 (Figure 4). Remember that some of the costs and benefits may not be obviously stated on the fact sheet. Write your thoughts about the cost versus the benefits of this project. Do you think it is worth the cost to the taxpayers? Be prepared to defend your decision.

Figure 3: **Graph of land area change over time for Trinity Island**

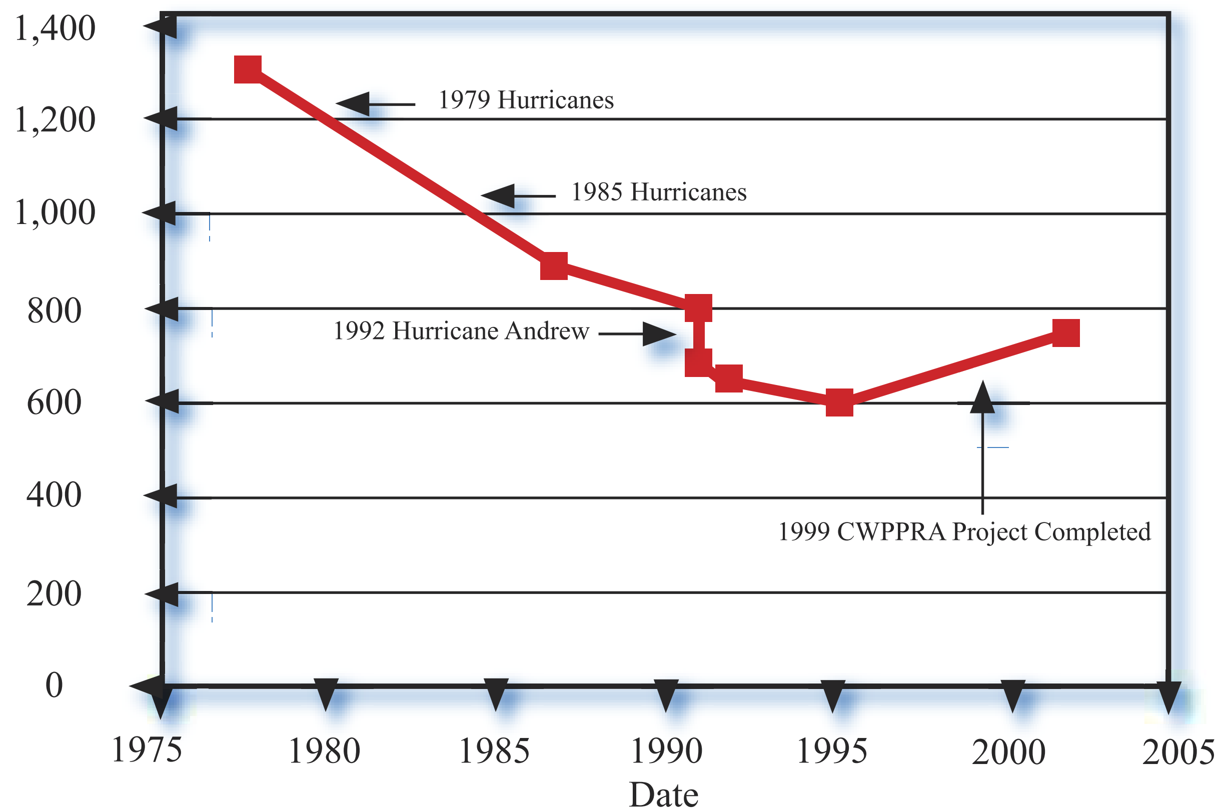


Figure 4: **Cost-Benefit Chart**

Costs	Benefits
10.7 million dollars	New land was created
Using sand from the shoals—Decreases the sediment budget	New wildlife habitat was created
Cost of plants, sand fences, etc.	New recreational areas were created
Dredging can have harmful effects on the environment	Protection from storms and surges in hurricanes

Conclusions about the project

Answers will vary

Blackline Masters

Blackline Master 1: Success of Restoration Projects

Blackline Master 2: Change Over Time for Trinity and East Islands

Blackline Master 3: Costs and Benefits of Restoration Projects

Extensions

1. Visit a barrier Island restoration project that involves pumping sediment onto the island.
2. Invite a speaker from the CWPPRA program to the class to provide in-depth information about the projects.
3. Assign a research project to groups of students that increases the amount of information gathered from the CWPPRA and other websites.
4. Arrange for your students to attend an event such as Ocean Commotion or Louisiana Earth Day's Wetland Tent and assign information gathering tasks involving interviewing experts and gathering a variety of data from exhibits.

Resources

William, S. J., Penland, S., Sallenger, A. H., (Eds). 1992. Louisiana Barrier Island Erosion Study: Atlas of shoreline Changes in Louisiana from 1853 to 1989. USGS.

http://marine.usgs.gov/fact-sheets/Barrier/barrier.html

www.lacoast.gov

Assessment

Rubric:

Objectives	Criteria				
Points	**1**	**2**	**3**	**4**	**Points**
Students wil analyze maps and graphed data showing a barrier island before and after restoration and before and after Hurricanes Katrina and Rita.	Student answered at least 50% of questions accurately for maps and graphed data.	Student answered more than 70% of questions accurately for maps and graphed data and made plausible inferences and predictions	Student answered at least 90% of the questions accurately for maps and graphed data, made plausible inferences and predictions and demonstrated an overall understanding of the meaning of the data for coastal restoration.	Student answered 100% of the questions accurately for maps and graphed data, made insightful inferences and predictions and showed deep understanding of the meaning of the data for coastal restoration.	
Students will evaluate the success of the restoration project using the data and by collecting online information.	The student gathered some data and was able use the information to list at least 1 cost and 1 benefit for the project.	The student gathered adequate information from data presented and on-line sources to list at least 2 costs and 2 benefits for the project.	The student gathered adequate information from data presented and on-line sources to list at least 3 costs and 3 benefits, including "hidden" costs and benefits and wrote thoughtful conclusions about the project's overall value and success.	The student gathered plenty of information from data presented and on-line sources to list at least 4 costs and 4 benefits, including "hidden" costs and benefits and wrote and defended insightful conclusions about the project's overall value and success.	
Students will predict the future changes in land area in the barrier islands.	Student used data presented to write at least one plausible prediction about the future of Louisiana's barrier islands.	The student used data presented and gathered from an on-line source to make more than one plausible prediction about the future of Louisiana's barrier islands.	The student used data presented and on-line source to make and defend at least insightful predictions about the future of Louisiana's barrier islands.	The student used data presented and gathered from an on-line source to make and defend at least 3 insightful predictions about the future of Louisiana's barrier islands.	
Total Points					
Teacher's Comments					

Keeping Our Heads Above Water

Success of Restoration Projects Activity 1-2

Student Name: ______________________________

Using figure 1:

1. Study Figure 1 on Blackline Master #2. It is a map of Trinity Island before and after restoration done by CWPPRA, the Coastal Wetlands Planning, Protection and Restoration Act. List three differences you observe between the first and second map. ______________________________

   ____

   ____

2. Go to the website http://www.lacoast.gov and click on the "projects" tab at the top of the page. An interactive map will come up. You can mouse over this map to find any project (in this case TE 24 on Trinity Island off the coast of Terrebonne Parish.) An active link will appear and you can navigate to the project Fact Sheet. An alternate way to navigate to a project is to use the alphabetic list of all the projects in the state, via the link found below the map. In order to use the list to find the barrier Islands in the Barataria Terrebonne estuary, search for projects in Terrebonne Parish (beginning with "TE") and then scroll down to Isles Dernieres Restoration Trinity Island (TE-24) and click on that project.

   Find TE-24 General Project Fact Sheet and open it up. Use this source of information to find the answers to the following questions:

   a. In what year was the project completed? ______________________________

   b. What was the size of the project area in acres? ______________________________

   How many acres of land were created by the project (not the same number)? ______________________________

   How many acres are projected to remain after 20 years? ______________________________

   c. Why will the area decrease over 20 years? ______________________________

   ____

Keeping Our Heads Above Water

d. How much did the project cost? ______________________

How much per acre is this (cost of project divided by the number of acres created)? ________

How was this project funded? ______________________

____

e. What is the main benefit of the project? ______________________

____

Using figure 2:

3. Use Figure 2 to answer the following questions about the effects of the 2005 hurricanes on Trinity Island.

a. What was the main impact of the hurricanes to Trinity and East Islands? ____________

____

Which of the two islands lost more land area? ______________________

b. Before August/ September 2005, Trinity and East Islands were separate.

What caused them to join? ______________________

c. Based on the information available, do you think the restoration projects on Trinity and East Island helped to prevent erosion during hurricanes Katrina and Rita? ____________

d. Do you think the restoration project was successful in its goal to prevent the disappearance of the islands? ______________________

Using figure 3:

4. Use Figure 3 to answer these questions about Trinity Island's change over time.

a. What was the land area of Trinity Island in 1978? ______

b. What was the land area after Hurricane Andrew in 1992? ______

c. What was the land area in 2002? ______

d. Calculate the change in area between 1978 and 1992 and between 1992 and 2002.

1978 to 1992 ______

1992 to 2002 ______

e. Do these figures indicate that the restoration project helped to increase the land area of the islands? ______

f. Draw a line on the graph to predict the land area change caused by Hurricanes Katrina and Rita (use Figure 2 to help you predict). ______

g. Based on the information in the graph, write a prediction for the land area change for Trinity Island for the time period 2002 – 2020. What known and unknown factors must be taken into account to make such a prediction? ______

______

h.What do you think your children will learn about Louisiana's barrier islands when they are your age? ______

______

5. Based on your answers above and the knowledge you have about the values of barrier islands to Louisiana's coastal residents, complete the cost/ benefit table for TE 24 (Figure 4). Remember that some of the costs and benefits may not be obviously stated on the fact sheet. Write your thoughts about the cost versus the benefits of this project. Do you think it is worth the cost to the taxpayers? Be prepared to defend your decision.

Keeping Our Heads Above Water

Change Over Time for Time for Trinity and East Islands   Activity 1-2

Student Name: ____________________

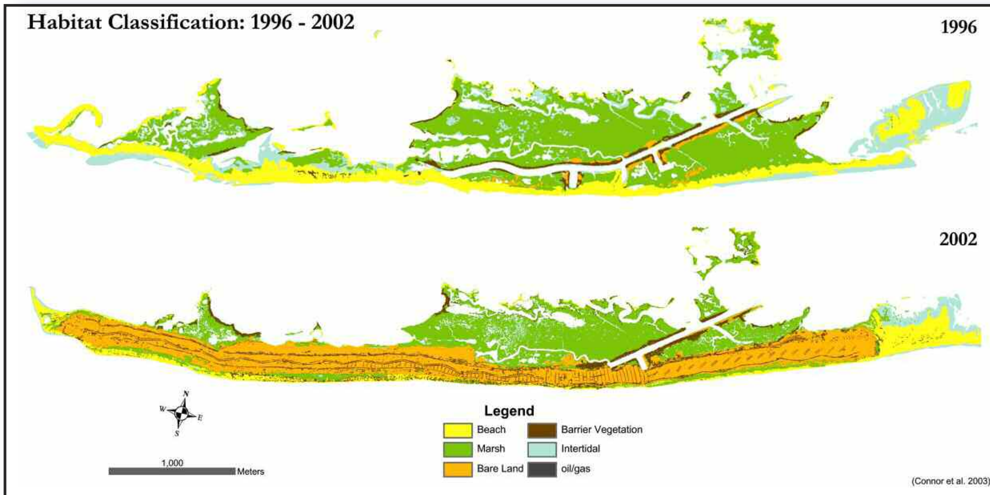


Figure 1: Habitat classification maps showing Trinity Island before and after the restoration project was completed. The “bare land” area on the bottom map is the sediment that was pumped onto the island. done by CWPPRA, the Coastal Wetlands Planing, Protection and Restoration Act.

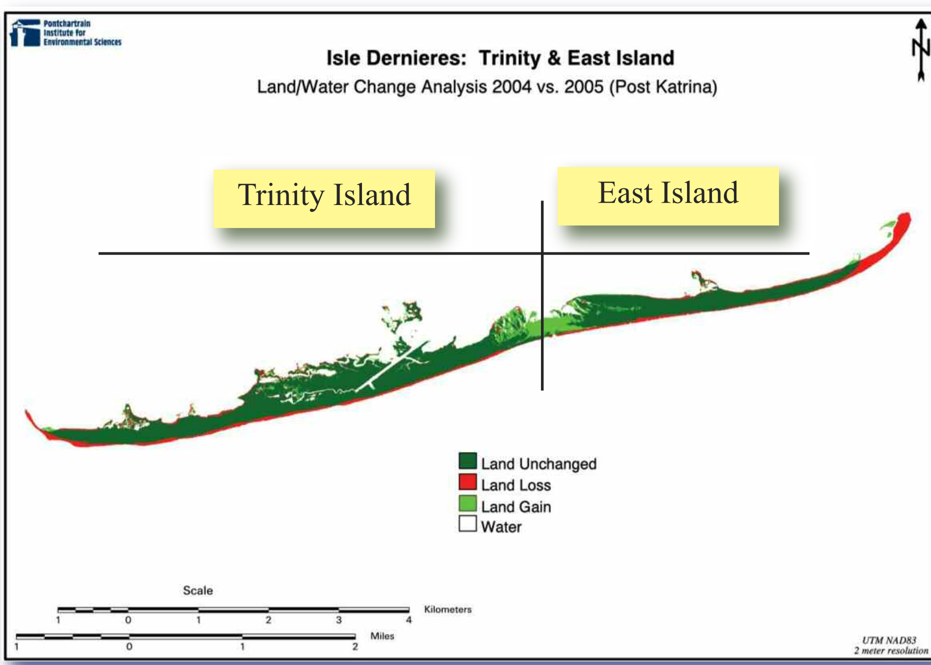
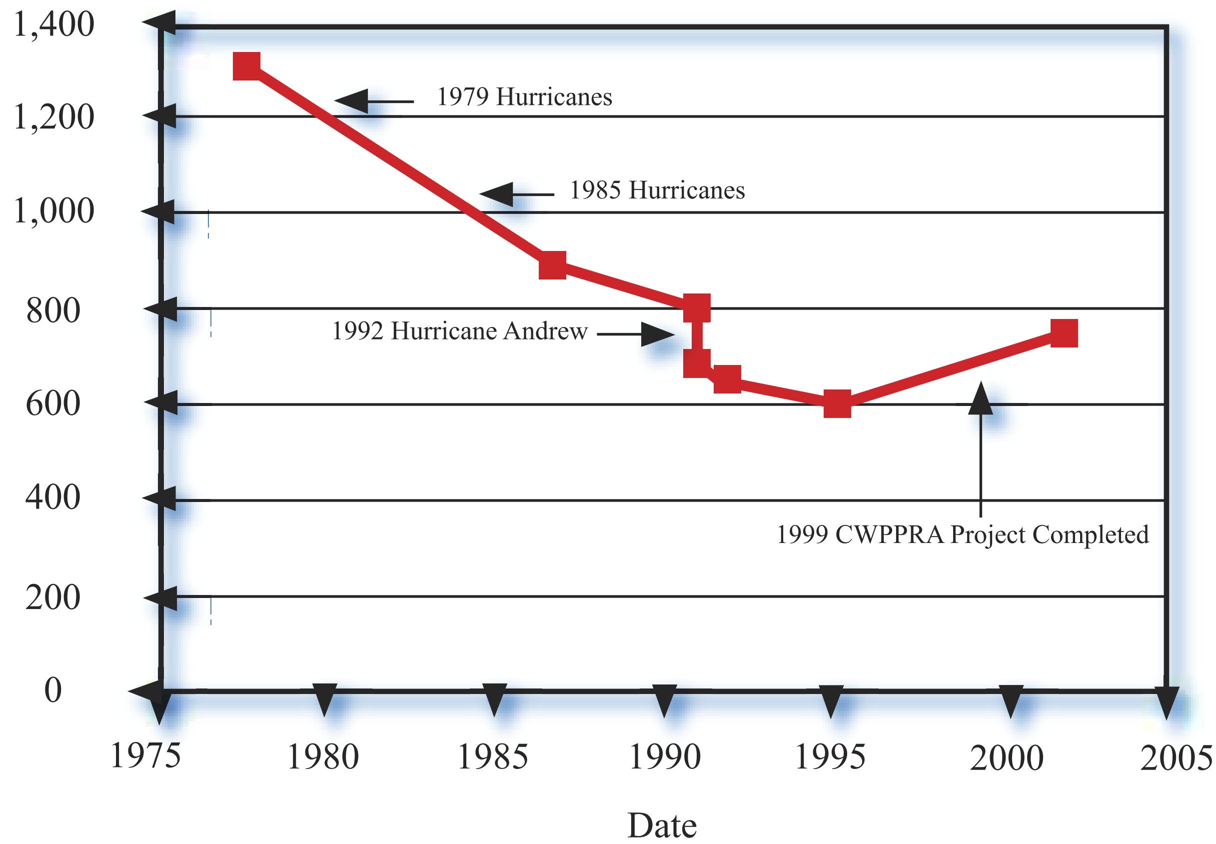


Figure 2: Land loss map showing Trinity and East Islands, now joined together by sediment deposition after hurricanes Katrina and Rita. The red area is the sediment lost due to the storm surges. The lighter green areas represent sediment deposition due to the storms.

Keeping Our Heads Above Water

Change Over Time for Time for Trinity and East Islands

Figure 3: **Graph of land area change over time for Trinity Island**



Blackline Master 3

Keeping Our Heads Above Water

Costs and Benefits of Restoration Projects

Activity 1-2

Student Name: ______________________________

Figure 4: **Cost-Benefit Chart**

Costs	Benefits

Conclusions about the project

Louisiana Coastal Wetlands Conservation and Restoration Task Force

October 2002
Cost figures as of: October 2011

Isles Dernieres Restoration Trinity Island (TE-24)

Project Status

Approved Date: 1992 **Cost:** $10.7 M
Project Area: 776 acres **Status** Completed June 1999
Net Benefit After 20 Years: 109 acres
Project Type: Barrier Island Restoration

Location

Trinity Island, which is one of five islands that make up the Isle Dernieres barrier island chain, is located approximately 13 miles south of Cocodrie, Louisiana, in Terrebonne Parish. It is bordered to the north by Lake Pelto and Terrebonne Bay, to the west by Whiskey Pass, to the south by the Gulf of Mexico, and to the east by New Cut and East Island.

Problems

The Isles Dernieres chain of barrier islands in Louisiana is experiencing land loss and fragmentation as a result of both natural processes and human activities. Trinity Island was expected to be lost by the year 2007 if no restoration was completed. The entire Isles Dernieres chain was projected to be lost by the year 2010 without restoration.

Louisiana's barrier islands buffer coastal areas from the storm surges that accompany hurricanes and tropical storms. They also protect interior fringe wetlands along the bay's shoreline from waves coming from the open Gulf of Mexico. Trinity Island serves as a nursery area for waterfowl and migratory species.

Restoration Strategy

The project required restoration of approximately 7.5 miles of both Trinity and East islands. It involved the construction of temporary perimeter containment dikes behind considerable stretches of the islands.

Sediment was suction-dredged from previously defined borrow areas of Lake Pelto and used to hydraulically fill the areas within the retaining dunes and dike structures.

An elevated marsh platform sloping from the dunes to the back bay dikes was created. The dunes and filled marsh were also planted with various species of vegetation.

Trinity Island sand fence and vegetative plantings.

Progress to Date

Construction of this Isles Dernieres project is complete. The dredging and shaping was completed in October 1998 and the vegetative planting was completed in June 1999.

Approximately 500 acres of island were created. The "net benefit after 20 years" figure listed above is the amount projected to remain of the created acreage at the end of the 20-year life of the project. Not included in the benefited acreage figure are benefits to the inland marsh because of reduced wave energy due to barrier island restoration.

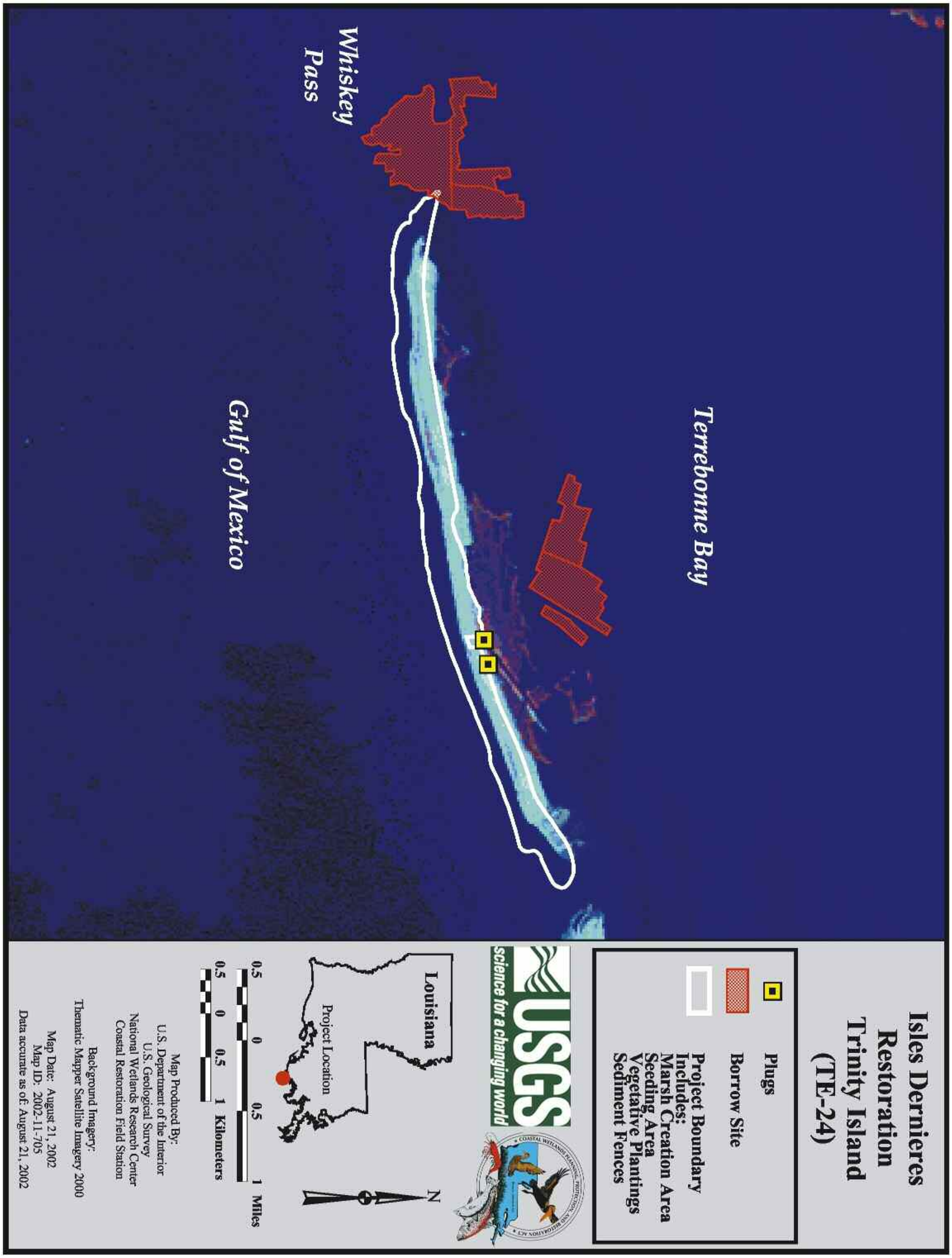
Dune elevation, along with sand fencing and vegetation, is enhancing the barrier island's capabilities to buffer storm surges to fringe marshes and coastal towns. The temporary containment dikes have degraded because of natural processes. Intertidal areas have developed naturally. This project is on Priority Project List 2.

For more project information, please contact:

Federal Sponsor:
Environmental Protection Agency
Baton Rouge, LA
(225) 389-0735

Local Sponsor:
Louisiana Department of Natural Resources
Baton Rouge, LA
(225) 342-7308

www.LaCoast.gov


Whiskey Pass
Terrebonne Bay
Gulf of Mexico
Isles Dernieres Restoration Trinity Island (TE-24)
Plugs
Borrow Site
Project Boundary Includes:
Marsh Creation Area
Seeding Area
Vegetative Plantings
Sediment Fences
USGS
science for a changing world
Louisiana
Project Location
N
0.5 0 0.5 1 Miles
0.5 0 0.5 1 Kilometers
Map Produced By:
U.S. Department of the Interior
U.S. Geological Survey
National Wetlands Research Center
Coastal Restoration Field Station
Background Imagery:
Thematic Mapper Satellite Imagery 2000
Map Date: August 21, 2002
Map ID: 2002-11-705
Data accurate as of: August 21, 2002

Grade Level Expectations

Lesson Two: Keeping Our Heads Above Water

Success of Restoration Projects

Lesson Two: Keeping Our Heads Above Water — Math

Graphing

3: GLE - 42	Match a data set to a graph, table, or chart and vice versa	D-2-E
8: GLE - 44	Use experimental data presented in tables and graphs to make outcome predictions of independent events	D-5-M

Data Analysis, Probability, and Discrete Math

4: GLE - 34	Summarize information and relationships revealed by patterns or trends in a graph, and use the information to make predictions	D-1-E
5: GLE - 28	Use various types of charts and graphs, including double bar graphs, to organize, display, and interpret data and discuss patterns verbally and in writing	D-1-M, D-2-M, P-3-M, A-4-M

Lesson Two: Keeping Our Heads Above Water — Science

Understanding Scientific Inquiry

5-8: GLE - 29	Explain how technology can expand the sensed and contribute to scientific knowledge	SI-M-B3
5-8: GLE - 33	Evaluate models; identify problems in design, and make recommendations for improvements	SI-M-B4
5: GLE - 38	Explain that, through the use of scientific processes and knowledge, people can solve problems, make decisions, and form new ideas	SI-M-B6
5-8: GLE - 40	Evaluate the impact of research on scientific thought, society, and the environment	SI-M-B7

Science and the Environment

5: GLE - 50	Describe the consequences of several types of human activities on local ecosystems (e.g., polluting streams, regulating hunting, introducing non-native species)	SE-M-A4
5: GLE - 32	Demonstrate the results of constructive and destructive forces using models or illustrations	ESS-M-A7
5: GLE - 33	Identify the processes that prevent or cause erosion	ESS-M-A7
7: GLE - 39	Analyze the consequences of human activities on ecosystems	SE-M-A4

Earth and Space Science Structure of the Earth

8: GLE - 19	Determine the results of constructive and destructive forces upon landform development with the aid of geologic maps of Louisiana	ESS-M-A7
8: GLE - 20	Describe how humans' actions and natural processes have modified coastal regions in Louisiana and other locations	ESS-M-A8
8: GLE - 21	Read and interpret topographic maps	ESS-M-A9

Science as Inquiry

9,10,11,12: GLE -5	Utilize math, organizational tools and graphing skills to solve problems	SI-H-A3

Lesson Two: Keeping Our Heads Above Water Social Studies

Geography Places and Regions

3: GLE - 9	Describe and compare the physical characteristics of various regions of Louisiana	G-1B-E1
8: GLE - 7	Explain how or why specific regions are changing as a result of physical phenomena (e.g., changes in the coastal wetlands)	G-1B-M3
8: GLE - 8	Identify and describe factors that cause a Louisiana region to change (e.g., natural occurrences, disasters, migration)	G-1B-M3

Geography Physical and Human Systems

3: GLE - 13	Identify examples of physical processes affecting Louisiana (e.g., coastal erosion, river changes)	G-1C-E1

Geography Environment and Society

3: GLE - 19	Identify and explain ways in which people in Louisiana modify the physical environment to meet basic needs and achieve certain purposes (e.g., clearing land for urban development)	G-1D-E1
4: GLE - 16	Identify ways in which people in the United States depend upon and modify the physical environment	G-1D-E1
4: GLE - 17	Identify natural disasters, their causes, areas prone to them, and how those disasters affect people and the environment	G-1D-E3
8: GLE - 17	Identify a contemporary Louisiana issue and research possible solutions	G-1D-M4
8: GLE -	Identify technological advances that expanded human capacity to modify the environment (e.g., steam, coal, electric, nuclear power, levees)	G-1D-H1
8: GLE -	Describe challenges to human systems and activities posed by the physical environment or the impact of natural processes and disasters on human systems (e.g., infrastructure)	G-1D-H2
8: GLE - 40	Analyze or evaluate strategies for dealing with environmental challenges (e.g., dams or dikes to control floods, fertilizer to improve crop production)	G-1D-H2

Geography The World in Spatial Terms

4: GLE - 1	Interpret different types of maps (using a map key/legend, compass rose, cardinal and intermediate directions, and distance scale)	G-1A-E1
5: GLE - 1	Describe the characteristics, functions, and applications of various types of maps	G-1A-M1
5: GLE - 2	Compare the uses of different types of maps, including two different types of maps of the same area	G-1A-M1
5: GLE - 3	Interpret a map, using a map key/legend and symbols, distance scale, compass rose, cardinal or intermediate directions, and latitude and longitude	G-1A-M2

Shifting Sands

Activity 1-3

Focus/ Overview

In this lesson students will use models to learn about the various habitats on a barrier island

Learning Objectives

The Students will . . .

- Create a model barrier island showing the typical profile and habitat zones.
- Research erosional features found on a barrier island.
- Simulate and make observations of the forces at work on the barrier islands.
- Learn through the simulations the concepts of tides, waves, storm surges, overwash, overwash channels, cuts, ebb and flood tide deltas, sand budget.

Creating a Model Barrier Island:

Materials List

- Clean sand (fine grained will work best)
- Large aluminum or plastic tray
- A stream table (if available)
- Water
- Hair dryer or wooden blocks to create waves
- Plant materials, etc. to represent plants growing in the various habitat zones on the island
- Figure 8: Profile of Barrier Island

BTNEP Connections
Habitat

Grade Levels
5-8, HS Earth and Environmental Science

Duration
1-50 minute class period

Subject Areas
Science or Art

Setting
Lab or Classroom

Extension Areas
Art

Vocabulary
beach, dune, barrier mud flat, salt marsh, submerged aquatic vegetation, overwash, overwash channels, cuts, flood tide delta, ebb tide delta, sand budget

University of New Orleans

Pontchartrain Institute for Environmental Sciences
University of New Orleans

Background Information

Refer to *The Barrier Islands of the Barataria-Terrebonne Barrier Island Background*—pages 1-12 at the beginning of this unit.

Advance Preparation

Be sure to plan the activities to fit into your class time schedules.

Make enough copies of the Blackline Master 1 so that there is one for each of the students.

Procedure

Note: There are two parts to this procedure to include "Build an Island," and "Investigating What Happens during a Storm." Complete each lesson section before students go on to the next.

Procedure Part 1: Build an Island

Students build a barrier island and draw or photograph their creation.

1. Discuss the typical profile of a barrier island (Figure 3). Show pictures of the different habitat zones. (Ideally, take a field trip to a barrier island to observe the habitat zones)

2. Have the students work in groups of 2 or 3 to conduct their own research in books and on the Internet about the habitat zones of barrier islands, including the plants and animals that live in each zone.

3. Students work in cooperative groups to create an island that has the following components:

   Beach Dune Barrier mud flat Salt Marsh

   Shallow water with submersed aquatic vegetation

4. Each member of the group is responsible for bringing in materials; for example, dried grass to represent sea oats on the dunes, green grass to represent marsh grass, small twigs to represent shrubs such as black mangrove and Iva.

5. The students can make cutouts of nesting birds such as brown pelicans.

6. The islands are created using fine, damp sand in a large tray. Add details such as foreshore, beach berm, primary and secondary dunes, etc.

7. Water can be carefully added to the tray to the appropriate level to represent mean tide.
   NOTE: Alternately, if you have access to a stream table, one large island can be created on the stream table.

8. Sketch or take digital photos of the islands to make comparisons later.

Procedure Part 2: Investigating What Happens During A Storm

Students investigate what happens to an island under different conditions by creating gentle and strong waves. This will give an idea of what happens under storm conditions.

9. Research and find pictures of examples of the following terms:

Overwash	Overwash channels
Cuts	Flood tide delta
Ebb tide deltas	Sand budget

10. Add more water to the tray (or stream table) to simulate an unusually high tide or a storm surge.

11. Use a hairdryer on low setting, or wooden blocks moved gently back and forth to create waves (different methods create different types of waves).

12. Observe what happens to the "shoreline" sand. Try making the waves come from different angles.

13. Sketch or take digital photos of the results.

14. Create larger waves by setting the hairdryer on high or moving the block more quickly back and forth (or even tipping the pan).

15. Let the waves wash over the island.

16. Observe where the sand moves. Sketch or take digital photos of the results. Identify features that were researched such as overwash, overwash channels, cuts, flood tide delta, ebb tide delta.

Blackline Masters

Blackline Master 1: Identifying Barrier Island Habitats

Blackline Master 2: Observations of Barrier Islands and Storm Effect on Shorelines

Part 1: Build an Island

Part 2: Investigating What Happens During a Storm

Blackline Master 3: Identifying Barrier Island Habitats

Assessment

Assess the drawings the students have made for accuracy. Grade the students' beach zone quizzes.

Extension

Encourage students to learn more about barrier islands and storms through reading:

Falls, Rose C. . (1893). *Cheniere Caminada or The Wind Of Death: The Story Of The Storm In Louisiana (Chapter VII. Last Island)* New Orleans: Hopkins' Printing Office. pp. 70-71. Retrieved 2009-07-15.

Hearn, Lafcadio (1889) *Chita: A Memory of Last Island (1917 edition)*. New York: Harper & Brothers Publishers. Retrieved 2009-07-15.

Resources

Louisiana's Barrier Islands: A Vanishing Resource

http://marine.usgs.gov/fact-sheets/Barrier/barrier.html

Barrier Island Atlas

http://www.coast2050.gov/reports/bia/BarrierIslandAtlas11x17.pdf

Blackline Master 1

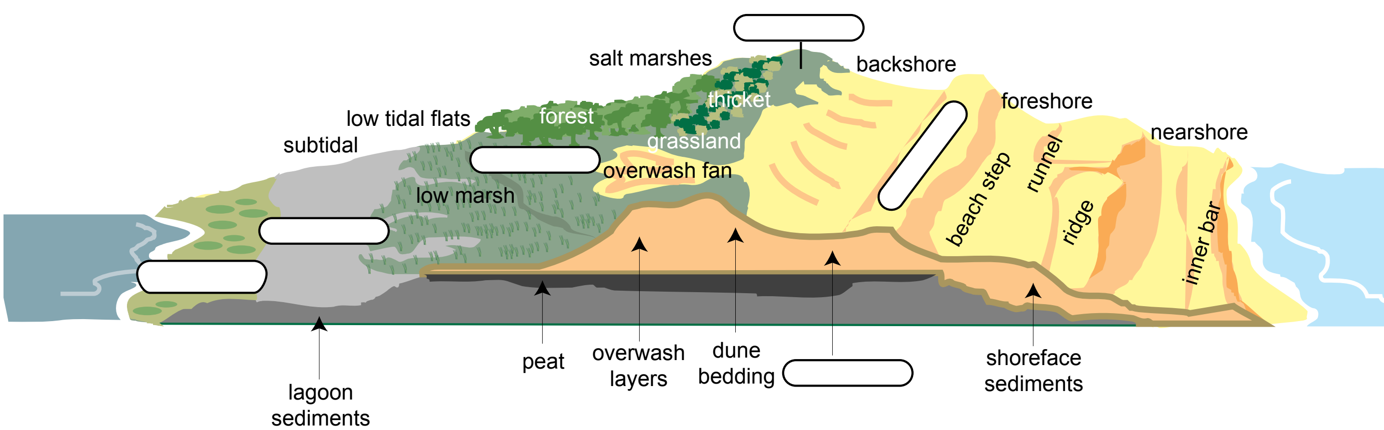
Identifying Barrier Island Habitats

Activity 1-3

Student Name: ______________________________

Instructions: **Using the list below, label the cross section of this barrier island. Remember not all features are present on all islands.**

Dunes	High marsh
Tidal flats	Marine vegetation
Berm	Berm crest



Blackline Master 2

Observations of Barrier Islands and Storm Effect on Shorelines

Activity 1-3

Student Name: ______________________________

Part 1: Build an Island

Instructions: **Sketch and label the islands that you created or take digital photos and place them here and then label.**

Blackline Master 2

Observations of Barrier Islands and Storm Effect on Shorelines

Activity 1-3

Student Name: ______________________________

Part 2: Investigating What Hapens During A Storm

Instructions: **Sketch or take digital photos that show how the shoreline has changed after the “storm.**

Blackline Master 3

Identifying Barrier Island Habitats

Activity 1-3

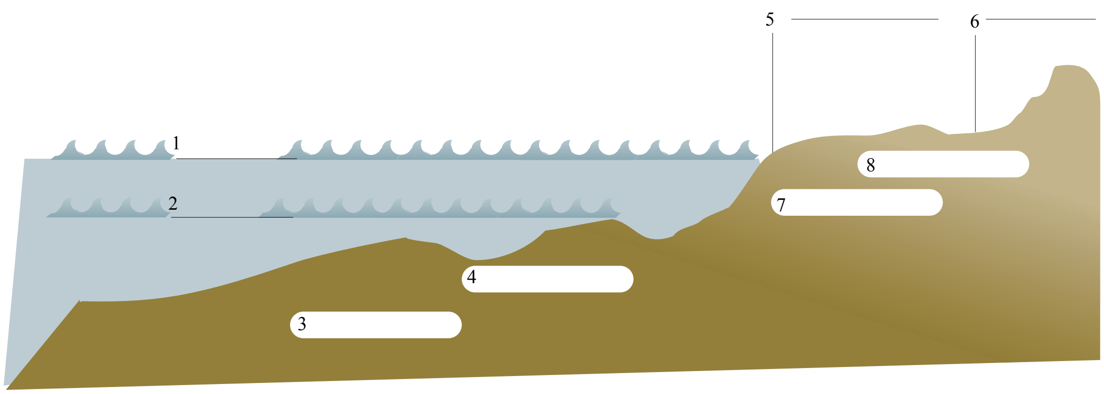
Student Name:

Identifying Barrier Island Habitats

Instructions: **Using the list below, label the cross sections of this barrier island. Remember not all features are present on all islands.**

Beach Zone Quiz

Read the beach zone definitions, then write the correct zone on the answer line in the illustration.



Beach Zone Definitions

forebeach: area between high and low tide

backbeach: downward sloping area above high tide mark

dune: gathering of sand that waves never reach

berm: area that only highest storm waves reach

high tide: upper reach of water

low tide: lowest receedance of water

longshore bar: build up of sand deeper than low tide

longshore trough: removal of sand due to along shore currents

Grade Level Expectations

Lesson Three: Shifting Sands

Lesson Three: Shifting Sands — Science

Science as Inquiry — The Abilities To Do Scientific Inquiry

3, 4: GLE - 1	Ask questions about objects and events in the environment (e.g., plants, rocks, storms)	SI-E-A1
3, 4: GLE - 2	Pose questions that can be answered by using students' own observations, scientific knowledge, and testable scientific investigations	SI-E-A1
3, 4: GLE - 3	Use observations to design and conduct simple investigations or experiments to answer testable questions	SI-E-A2
3, 4: GLE - 4	Predict and anticipate possible outcomes	SI-E-A2
3: GLE - 5	Use a variety of methods and materials and multiple trials to investigate ideas (observe, measure, accurately record data)	SI-E-A1
3: GLE - 10	Combine information, data, and knowledge from one or more of the science content areas to reach a conclusion or make a prediction	SI-E-A5
3: GLE - 11	Use a variety of appropriate formats to describe procedures and to express ideas about demonstrations or experiments (e.g., drawings, journals, reports, presentations, exhibitions, portfolios)	SI-E-A6
4: GLE - 5	Identify variables to ensure that only one experimental variable is tested at a time	SI-E-A2
4: GLE - 6	Use a variety of methods and materials and multiple trials to investigate ideas (observe, measure, accurately record data)	SI-E-A2
4: GLE - 10	Express data in a variety of ways by constructing illustrations, graphs, charts, tables, concept maps, and oral and written explanations as appropriate	SI-E-A5 SI-E-B4
4: GLE - 12	Use a variety of appropriate formats to describe procedures and to express ideas about demonstrations or experiments (e.g., drawings, journals, reports, presentations, exhibitions, portfolios)	SI-E-A6

Science as Inquiry The Abilities To Do Scientific Inquiry cont.

5, 6, 7, 8: GLE - 1	Generate testable questions about objects, organisms, and events that can be answered through scientific investigation	SI-M-A1
5, 6, 7, 8: GLE - 2	Identify problems, factors, and questions that must be considered in a scientific investigation	SI-M-A1
5, 6, 7, 8: GLE - 3	Use a variety of sources to answer questions	SI-M-A1
5, 6, 7, 8: GLE - 4	Design, predict outcomes, and conduct experiements to answer guiding questions	SI-M-A2
5, 6, 7, 8: GLE - 5	Identify independent variables, dependent variables, and variables that should be controlled in designing an experiment	SI-M-A2
5, 6, 7, 8: GLE - 6	Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations	SI-M-A3
5, 6, 7, 8: GLE - 7	Record observations using methods that complement investigations (e.g., journals, tables, charts)	SI-M-A3
5, 6, 7, 8: GLE - 8	Use consistency and precision in data collection, analysis, and reporting	SI-M-A3
5, 6, 7, 8: GLE - 12	Use data and information gathered to develop an explanation of experimental results	SI-M-A4
5, 6, 7, 8: GLE - 13	Identify patterns in data to explain natural events	SI-M-A4
5, 6, 7, 8: GLE - 14	Develop models to illustrate or explain conclusions reached through investigaton	SI-M-A5
5, 6, 7, 8: GLE - 15	Identify and explain the limitations of models used to represent the natural world	SI-M-A5
5, 6, 7, 8: GLE - 16	Use evidence to make inferences and predict trends	SI-M-A5
5, 6, 7, 8: GLE - 17	Recognize that there may be more than one way to interpret a given set of data, which can result in alternative scientific explanations and predictions	SI-M-A6
5, 6, 7, 8: GLE - 18	Identify faulty reasoning and statements that misinterpret or are not supported by the evidence	SI-M-A6
5, 6, 7, 8: GLE - 21	Distinguish between *observations* and *inferences*	SI-M-A7
5, 6, 7, 8: GLE - 22	Use evidence and observatons to explain and communicate the results of investigations	SI-M-A7

Science as Inquiry The Abilities To Do Scientific Inquiry cont.

9, 10, 11, 12: GLE - 1	Write a testable question or hypothesis when given a topic	SI-H-A1
9, 10, 11, 12: GLE - 2	Describe how investigations can be observation, description, literature survey, classification, or experimentation	SI-H-A2
9, 10, 11, 12: GLE - 3	Plan and record step-by-step procedures for a valid investigation, select equipment and materials, and identify variables and controls	SI-H-A2
9, 10, 11, 12: GLE - 4	Conduct an investigation that includes multiple trials and record, organize, and display data appropriately	SI-H-A2
9, 10, 11, 12: GLE - 7	Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations)	SI-H-A4

Understanding Scientific Inquiry

3, 4: GLE - 13	Identify questions that need to be explained through further inquiry	SI-E-B1
4: GLE - 15	Distinquish between what is known and what is unknown in scientific investigations	SI-E-B1
4: GLE -16	Select the best experimental design to answer a given testable question	SI-E-B2
4: GLE - 20	Determine whether further investigations are needed to draw valid conclusions	SI-E-B6
4: GLE - 21	Use evidence from previous investigations to ask additional questions and to initiate further explorations	SI-E-B6
5, 6, 7, 8: GLE - 25	Compare and critique scientific investigations	SI-M-B1
5, 6, 7, 8: GLE - 26	Use and describe alternate methods for investigating different types of testable quesitons	SI-M-B1
5, 6, 7, 8: GLE - 27	Recognize that science uses processes that involve a logical and empirical, but flexible, approach to problem solving	SI-M-B1
5, 6, 7, 8: GLE - 33	Evaluate models, identify problems in design, and make recommendations for improvement	SI-M-B4
5, 6, 7, 8: GLE - 37	Critique and analyze their own inquiries and the inquiries of others	SI-M-B5

Earth and Space Science Properties of Earth Materials

3: GLE - 46	Describe earth processes that have affected selected physical features in students' neighborhoods (e.g., rusting, weathering, erosion)	ESS-E-A1
4: GLE - 63	Demonstrate and explain how Earth's surface is changed as a result of slow and rapid processes (e.g., sand dunes, canyons, volcanoes, earthquakes)	ESS-E-A5 ESS-E-A1

Earth and Space Science Structure of the Earth

5, 6, 7, 8: GLE - 32	Demonstrate the results of constructive and destructive forces using models or illustrations	ESS-M-A7
5, 6, 7, 8: GLE - 33	Identify the processes that prevent or cause erosion	ESS-M-A7
8: GLE - 19	Determine the results of constructive and destructive forces upon landform development with the aid of geologic maps of Louisiana	ESS-M-A7
8: GLE - 20	Describe how humans' actions and natural processes have modified coastal regions in Louisiana and other locations	ESS-M-A8

Earth and Space Science Earth History

5, 6, 7, 8: GLE - 38	Estimate the range of time over which natural events occur (e.g., lightning in seconds, mountain formation over millions of years)	ESS-M-B3

Science and the Environment

8: GLE - 53	Distinguish among several examples of erosion (e.g., stream band, topsoil, coastal) and describe common preventive measures	SE-M-A10

Barrier Islands

Shifting Sands—
How Dunes Form
Part 2

Activity 1-4

BTNEP Connections
Habitat

Grade Levels
5-8, HS Earth and Environmental Science

Duration
1-50 minute class period

Subject Areas
Science or Art

Setting
Lab or Classroom

Vocabulary
beach, dune, prevailing winds, barrier mud flat, salt marsh, submerged aquatic vegetation,
overwash, overwash channels, cuts, flood tide delta, ebb tide delta, sand budget

Focus/ Overview

The students will use **dry** sand to learn about dunes.

Learning Objectives

The Students will . . .

- Conduct research about dune formation, answering the question: What builds a dune?
- Design an investigation of either natural dune formation or a method of artificially building dunes using natural forces and man-made objects.
- Suggest ways by which dunes can be created to help sustain barrier islands.

Creating a Model Barrier Island:

Materials List

- Clean **dry** sand (fine grained will work best)
- Large aluminum or plastic baking tray
- Hair dryers
- Popsicle sticks, twigs, pebbles, etc.

Background Information

Refer to *The Barrier Islands of the Barataria-Terrebonne Barrier Island Background*—pages 1-12 at the beginning of this unit.

Advance Preparation

This activity requires **dry** sand. Be sure to plan the activity with plenty of time to clean up.

Procedure: How Do Dunes Form?

Students build dunes using various tools to help reinforce the dune structure.

1. The students work in their groups to collect information from books and the Internet about how dunes form.
2. Each cooperative group works with a supply of sand in an aluminum tray, a hair dryer and a variety of selected materials they want to test as dune building materials.
3. The students place the objects in the sand and use the hair dryer as a wind source to create dunes.
4. Variables such as the **shape and size** of the object, the **orientation** of the object to the "prevailing wind", etc. should be taken into account. The students should run several trials for different dune building methods to select a preferred method.
5. The students assess the success of their alternate methods, recording their results in a results table and report to the class.
6. Investigate methods used in restoration projects to trap sand on barrier islands. There are many examples in Louisiana and elsewhere of fencing projects designed to build dunes.
7. Students assist with building fences and planting vegetation in a restoration project.

Investigation Conclusion

Write a conclusion to explain which method proved most effective in building dunes.

Class Critique of Methods

After each group completes their experiment, a spokesperson can report findings to the whole class. The class then discusses the pros and cons of the experimental design.

Blackline Masters

Blackline Master 1: Investigating Results of Dune Formation and Restoration

Assessment

Assess the students' results table and/or their report to the class. Require students to write a conclusion to explain which method proved most effective in building dunes. After each group completes their experiment, a spokesperson can report findings to the whole class. The class then discusses the pros and cons of the experimental design.

Extension

Encourage students to learn more about dunes and coastal restoration of barrier islands. Have them visit www.LaCoast.gov and investigate one of the following projects. Advanced students should investigate technical documents as well.

PPL	Number	Project Name	Agency	Project Types	Parishes
19	BA-76	Cheniere Ronquille Barrier Island Restoration	NMFS	Barrier Island Restoration	Plaquemines
14	BA-40	Riverine Sand Mining/ Scofield Island Restoration	NMFS	Barrier Island Restoration	Plaquemines
11	BA-35	Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration	NMFS	Barrier Island Restoration	Plaquemines
11	BA-38	Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass Restoration	NMFS	Barrier Island Restoration	Plaquemines
11	TE-47	Ship Shoal: Whiskey West Flank Restoration	EPA	Barrier Island Restoration	Terrebonne
09	BA-30	East/West Grand Terre Islands Restoration (Deauthorized)	NMFS	Barrier Island Restoration	Jefferson
09	PO-27	Chandeleur Islands Marsh Restoration	NMFS	Barrier Island Restoration	Plaquemines, St. Bernard
09	TE-37	New Cut Dune and Marsh Restoration	EPA	Barrier Island Restoration	Terrebonne
09	TE-40	Timbalier Island Dune and Marsh Creation	EPA	Barrier Island Restoration	Terrebonne
03	TE-25	East Timbalier Island Sediment Restoration, Phase 1	NMFS	Barrier Island Restoration	Lafourche
04	TE-30	East Timbalier Island Sediment Restoration, Phase 2	NMFS	Barrier Island Restoration	Lafourche
03	TE-27	Whiskey Island Restoration	EPA	Barrier Island Restoration	Terrebonne
02	TE-24	Isles Dernieres Restoration Trinity Island	EPA	Barrier Island Restoration	Terrebonne
01	TE-20	Isles Dernieres Restoration	EPA	Barrier Island Restoration	Terrebonne
05	TE-29	Raccoon Island Breakwaters Demonstration	NRCS	Barrier Island Restoration, Demonstration	Terrebonne
01	TE-18	Timbalier Island Planting Demonstration	NRCS	Barrier Island Restoration, Demonstration, Vegetative Planting	Terrebonne

Encourage older students to participate in volunteer activities such as sand fence building and planting vegetation in restoration projects.

Resources

Internet Web Quest Barrier Islands—To build or not to build
http://www.glencoe.com/sec/science/webquest/content/barrierisland.shtml

Louisiana Barrier Islands: A Vanishing Resource
http://pubs.usgs.gov/fs/barrier-islands/

The Coastal Wetlands Planning, Protection and Restoration Act Web Resources
http://lacoast.gov

Web Quest: Louisiana Wetlands—An American Resource
http://lacoast.gov/new/Ed/WebQuest.aspx

Blackline Master 1

Investigating Results of Dune Formation and Restoration

Activity 1-4

Student Name: ______________________

Instructions

Using the table below, first identify and record which change you made and record it under the independent variable. Record the change in the dune. Repeat each trial three times and record your observations.

Independent Variable (e.g. wind direction) (e.g. height of object on "beach")	Dependent Variable (e.g. height of dune, slope of the dune)	Trial 1 Observations	Trial 2 Observations	Trial 3 Observations

Conclusions

Barrier Islands

Grade Level Expectations

Lesson Four: Shifting Sands

How Dunes Form

Lesson Four: Shifting Sands How Dunes Form — Science

Science as Inquiry — The Abilities To Do Scientific Inquiry

3, 4: GLE - 1	Ask questions about objects and events in the environment (e.g., plants, rocks, storms)	SI-E-A1
3, 4: GLE - 2	Pose questions that can be answered by using students' own observations, scientific knowledge, and testable scientific investigations	SI-E-A1
3, 4: GLE - 3	Use observations to design and conduct simple investigations or experiments to answer testable questions	SI-E-A2
3, 4: GLE - 4	Predict and anticipate possible outcomes	SI-E-A2
3: GLE - 5	Use a variety of methods and materials and multiple trials to investigate ideas (observe, measure, accurately record data)	SI-E-A1
3: GLE - 10	Combine information, data, and knowledge from one or more of the science content areas to reach a conclusion or make a prediction	SI-E-A5
3: GLE - 11	Use a variety of appropriate formats to describe procedures and to express ideas about demonstrations or experiments (e.g., drawings, journals, reports, presentations, exhibitions, portfolios)	SI-E-A6
4: GLE - 5	Identify variables to ensure that only one experimental variable is tested at a time	SI-E-A2
4: GLE - 6	Use a variety of methods and materials and multiple trials to investigate ideas (observe, measure, accurately record data)	SI-E-A2
4: GLE - 10	Express data in a variety of ways by constructing illustrations, graphs, charts, tables, concept maps, and oral and written explanations as appropriate	SI-E-A5 SI-E-B4
4: GLE - 12	Use a variety of appropriate formats to describe procedures and to express ideas about demonstrations or experiments (e.g., drawings, journals, reports, presentations, exhibitions, portfolios)	SI-E-A6

Science as Inquiry   The Abilities To Do Scientific Inquiry cont.

5, 6, 7, 8: GLE - 1	Generate testable questions about objects, organisms, and events that can be answered through scientific investigation	SI-M-A1
5, 6, 7, 8: GLE - 2	Identify problems, factors, and questions that must be considered in a scientific investigation	SI-M-A1
5, 6, 7, 8: GLE - 3	Use a variety of sources to answer questions	SI-M-A1
5, 6, 7, 8: GLE - 4	Design, predict outcomes, and conduct experiements to answer guiding questions	SI-M-A2
5, 6, 7, 8: GLE - 5	Identify independent variables, dependent variables, and variables that should be controlled in designing an experiment	SI-M-A2
5, 6, 7, 8: GLE - 6	Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations	SI-M-A3
5, 6, 7, 8: GLE - 7	Record observations using methods that complement investigations (e.g., journals, tables, charts)	SI-M-A3
5, 6, 7, 8: GLE - 8	Use consistency and precision in data collection, analysis, and reporting	SI-M-A3
5, 6, 7, 8: GLE - 12	Use data and information gathered to develop an explanation of experimental results	SI-M-A4
5, 6, 7, 8: GLE - 13	Identify patterns in data to explain natural events	SI-M-A4
5, 6, 7, 8: GLE - 14	Develop models to illustrate or explain conclusions reached through investigaton	SI-M-A5
5, 6, 7, 8: GLE - 15	Identify and explain the limitations of models used to represent the natural world	SI-M-A5
5, 6, 7, 8: GLE - 16	Use evidence to make inferences and predict trends	SI-M-A5
5, 6, 7, 8: GLE - 17	Recognize that there may be more than one way to interpret a given set of data, which can result in alternative scientific explanations and predictions	SI-M-A6
5, 6, 7, 8: GLE - 18	Identify faulty reasoning and statements that misinterpret or are not supported by the evidence	SI-M-A6
5, 6, 7, 8: GLE - 21	Distinguish between *observations* and *inferences*	SI-M-A7
5, 6, 7, 8: GLE - 22	Use evidence and observatons to explain and communicate the results of investigations	SI-M-A7

Science as Inquiry The Abilities To Do Scientific Inquiry cont.

9, 10, 11, 12: GLE - 1	Write a testable question or hypothesis when given a topic	SI-H-A1
9, 10, 11, 12: GLE - 2	Describe how investigations can be observation, description, literature survey, classification, or experimentation	SI-H-A2
9, 10, 11, 12: GLE - 3	Plan and record step-by-step procedures for a valid investigation, select equipment and materials, and identify variables and controls	SI-H-A2
9, 10, 11, 12: GLE - 4	Conduct an investigation that includes multiple trials and record, organize, and display data appropriately	SI-H-A2
9, 10, 11, 12: GLE - 7	Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations)	SI-H-A4

Understanding Scientific Inquiry

3, 4: GLE - 13	Identify questions that need to be explained through further inquiry	SI-E-B1
4: GLE - 15	Distinquish between what is known and what is unknown in scientific investigations	SI-E-B1
4: GLE -16	Select the best experimental design to answer a given testable question	SI-E-B2
4: GLE - 20	Determine whether further investigations are needed to draw valid conclusions	SI-E-B6
4: GLE - 21	Use evidence from previous investigations to ask additional questions and to initiate further explorations	SI-E-B6
5, 6, 7, 8: GLE - 25	Compare and critique scientific investigations	SI-M-B1
5, 6, 7, 8: GLE - 26	Use and describe alternate methods for investigating different types of testable quesitons	SI-M-B1
5, 6, 7, 8: GLE - 27	Recognize that science uses processes that involve a logical and empirical, but flexible, approach to problem solving	SI-M-B1
5, 6, 7, 8: GLE - 33	Evaluate models, identify problems in design, and make recommendations for improvement	SI-M-B4
5, 6, 7, 8: GLE - 37	Critique and analyze their own inquiries and the inquiries of others	SI-M-B5

Earth and Space Science Properties of Earth Materials

3: GLE - 46	Describe earth processes that have affected selected physical features in students' neighborhoods (e.g., rusting, weathering, erosion)	ESS-E-A1
4: GLE - 63	Demonstrate and explain how Earth's surface is changed as a result of slow and rapid processes (e.g., sand dunes, canyons, volcanoes, earthquakes)	ESS-E-A5 ESS-E-A1

Earth and Space Science Structure of the Earth

5, 6, 7, 8: GLE - 32	Demonstrate the results of constructive and destructive forces using models or illustrations	ESS-M-A7
5, 6, 7, 8: GLE - 33	Identify the processes that prevent or cause erosion	ESS-M-A7
8: GLE - 19	Determine the results of constructive and destructive forces upon landform development with the aid of geologic maps of Louisiana	ESS-M-A7
8: GLE - 20	Describe how humans' actions and natural processes have modified coastal regions in Louisiana and other locations	ESS-M-A8

Earth and Space Science Earth History

5, 6, 7, 8: GLE - 38	Estimate the range of time over which natural events occur (e.g., lightning in seconds, mountain formation over millions of years)	ESS-M-B3

Science and the Environment

8: GLE - 53	Distinguish among several examples of erosion (e.g., stream band, topsoil, coastal) and describe common preventive measures	SE-M-A10

Barrier Islands

Barrier Island Inhabitants

Barrier Island Ecology — Activity 1-5

Adapted from *Lesson on the Lake, An Educators Guide to the Lake Pontchartrain Basin,* Lake Pontchartrain Basin Foundation

Focus/ Overview

Different plants and animals inhabit different environments on Earth.

Learning Objectives

The Students will . .

- Conduct research about the four distinct habitats of a barrier island: Beach/intertidal zone, Dune zone, Salt Marsh zone, Subtidal zone (always covered by water)
- Identify one or more species of plant or animal that lives in each of the habitats, listing the characteristics of the species that adapt it to its specialized habitat.

Materials List

- Access to the Internet
- Books and pamphlets about barrier island ecology
- Blackline Masters 1, 2 and 3

Background Information:

While barrier islands appear to be small habitats there are actually distinct identifiable sub areas to include: intertidal zones, dune zones, salt marsh zones and sub-tidal zones.

Advance Preparation:

Copy the blackline masters and provide each student with at least one organism to research.

BTNEP Connection
Living Resources

Grade Level
3-12

Duration
2 50-minutes class periods

Subject Area
Science and English

Setting
Classroom

Extension Areas
Art, Language Art

Original Source
Lessons on the Lake

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Pontchartrain Institute for Environmental Sciences
University of New Orleans

Procedure: Class Food Web

- Introduce the students to some of the organisms found on Isles Dernieres or the Timbalier Islands (See list, page 43). (Adapted from BTNEP curriculum guide: Wetlands field Trip: Section 1, Activity 9, Page 10.

- Assign one or two organisms (a variety of plants and animals) to each student or group of students. They can work individually or in cooperative groups. The students use reference materials and the Internet to find out more details about the plants and animals, focusing on their physical and behavioral adaptations to life on a barrier island. The students complete the blackline master with information they gather. Be sure students create a reference sheet or bibliography.

- Have the students report to the class about their chosen organism(s) with an oral presentation.

- After the research is complete, create a class food web. Students take the roles of their organisms, create a name card and pass yarn from organism to organism to illustrate the path of the energy through the ecosystem. Remember to designate one person as "Sun" to start the energy flow! Discuss the complexity of the food web and how the energy diminishes as it passes through the food web.

Extension:

- Create concept maps for a selection of the plants and animals.

- The students can work together to write poetry or a song about their plant or animal.

Blackline Masters

See the three blackline masters at the end of the lesson.

Blackline Master 1: Identifying Inhabitants of Various Barrier Island Environments

Blackline Master 2: Food Web Summary Reference Sheet

Blackline Master 3: Food Web Summary Diagram (to be done after Food Web exercise)

Assessments

Grade students oral presentations using a rubric.

Extensions

Students may work together to write poetry or a song about their plant or animal. Students may create a drawing of their organism. Students may create a scale model of one of the organisms. The class may choose to create a mural of a barrier island to include organisms they researched.

Resources

Quickly find science images, including animal and plant, weather and space, and earth and sun images and more. The information is free and no registration is required.

Science.gov > Special Collections > Image Search
http://www.science.gov/scigovimage/

Science.gov Image Search searches the metadata from images provided by three Federal agencies with more image databases expected to be added in the coming months. The current federated search includes:

• The National Biological Information Infrastructure **(NBII) Library of Images from the Environment (LIFE)**, a collection of high-quality photographs, illustrations, and graphics covering a wide range of topics, including images of plants, animals, fungi, microorganisms, habitats, wildlife management, environmental topics, and biological study/fieldwork.
http://life.nbii.gov/dml/home.do

- The National Aeronautics and Space Administration **(NASA) Image eXchange (NIX)**, a search engine of NASA's mulitmedia collections, including images of space flight wind tunnel, solar system, aircraft, and education initiatives.
http://nix.larc.nasa.gov/advanced

- The National Oceanic and Atmospheric Administration **(NOAA) Photo Library**, a collection spanning centuries of time and much of the natural world from the center of the earth to the surface of the sun.
http://www.photolib.noaa.gov/search.html

- Educator's Guide to the Barataria-Terrebonne Estuary **Wetland Webs**
http://www.btnep.org/Libraries/Lessons/Educators Guide to the Barataria-Terrebonne Estuary Curriculum.sflb.ashx

http://life.nbii.gov/dml/categories.do?id=50001&pt=l1

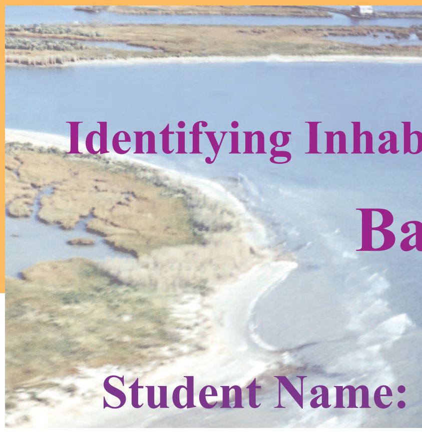
Plant and Animal Checklist: Barrier Islands/ Beaches

Plants

Iva
Groundsel
Glasswort
Oyster Grass
Sea Oxeye
Black Mangrove
Wire Grass
American Beach Grass
Panic Grass
Beach Tea

Animals

Brown Pelican
Laughing Gull
Willet
Plover
Sandpiper
Frigate Bird
Roseate Spoonbill
Bottle-nosed Dolphin
Speckled Trout
Flounder
Red Fish
Hermit Crab
White Shrimp
Skimmer
Atlantic Croaker
Oyster
Blue Crab
Striped Mullet
Reddish Egret
Menhaden



Blackline Master 1

Identifying Inhabitants of Various Barrier Island Environments

Barrier Island Inhabitants

Activity 1-5

Student Name: ______________________________

ORGANISMS NAME
(Genus species)

IMAGE OR DRAWING

HABITAT DESCRIPTION

DIET

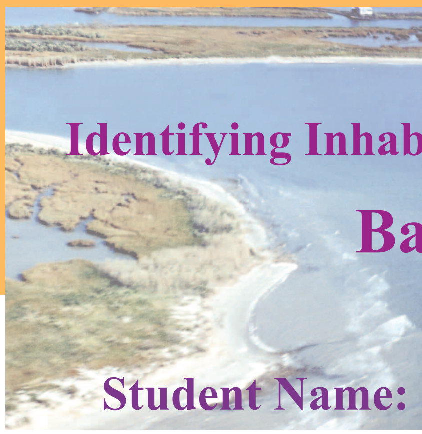
PHYSICAL DESCRIPTION

PREDATORS

PHYSICAL ADAPTATIONS

BEHAVIORAL ADAPTATIONS

Other Interesting Facts:



Blackline Master 1

Identifying Inhabitants of Various Barrier Island Environments

Barrier Island Inhabitants

Activity 1-5

Student Name: **EXAMPLE OF COMPLETED REPORT**

ORGANISMS NAME
(Genus species)

Bottlenose Dolphin
(Tursiops truncatus)

IMAGE OR DRAWING

HABITAT DESCRIPTION

This species found in our bays is seen most frequently at passes to the Gulf.

DIET

Dolphins are active predators and eat a wide variety of fishes, squids, and crustaceans such as shrimp.

PHYSICAL DESCRIPTION

Bottlenose Dolphins are stout-bodied animals with a short beak and erect dorsal fin. Their coloration is grey tinged with purple above and paler undersides. Adults can grow to about 10 feet.

PREDATORS

Bottlenose dolphins are a top predator in the ocean, with few predators of their own.

Sharks and killer whales occasionally prey upon the very old, weak, or young.

Humans present a greater threat to this species through incidental catch or direct harassment.

PHYSICAL ADAPTATIONS

Bottlenose Dolphins are excellent swimmers. They can hold their breath for up to 12 minutes and exchange 80% of the air in their lungs each time they breathe. Slow heart rate when diving.

BEHAVIORAL ADAPTATIONS

Depending on habitat, most bottlenose dolphins regularly dive to depths of 3 to 46 meters (10-150 ft.).

Other Interesting Facts:

You may find marine mammals stranded on beaches. Although the causes of strandings are often unclear, they may be due to disease, injuries or health problems associated with pollution. If you come across a live stranding, keep the animal wet while keeping its blowhole above water. Reduce stress by keeping crowds and pets away and stay with the animal. They are protected under the Marine Mammal Protection Act (MMPA)

Blackline Master 2

Food Web Summary Sheet

Barrier Island Inhabitants

Activity 1-5

Student Name: ______________________________

Reference Page

Name of Organism

Instructions

Below list the links you used from the Web or list the books or magazines you used to gather your information. Three references are required.

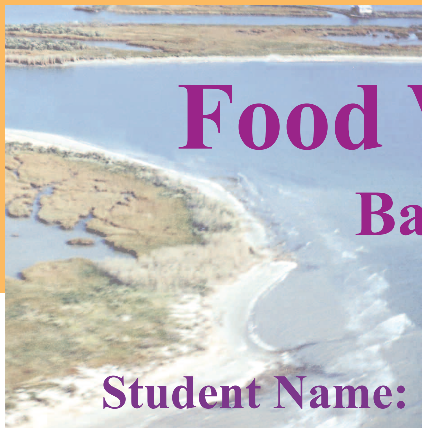
1

2

3

4

5



Blackline Master 3

Food Web Summary Sheet

Barrier Island Inhabitants

Activity 1-5

Student Name: ____________________

Food Web Summary

Name of Organism

Instructions

Draw a food web diagram linking organism to organism to illustrate the path of the energy through the ecosystem. Use the sun to start the energy flow. Draw objects sizing them in relation to how the energy diminishes as it passes through the food web.

Grade Level Expectations

Lesson Five: Barrier Island Inhabitants

Barrier Island Ecology

Lesson Five: Barrier Inhabitants Science

Life Science Characteristics of Organisms

3: GLE - 35	Compare structures (parts of the body) in a variety of animals (e.g. fish, mammals, reptiles, amphibians, birds, insects)	LS-E-A3
3: GLE - 36	Compare structures (e.g., roots, leaves, stems, flowers, seeds) and their functions in a variety of plants	LS-E-A3
3: GLE - 37	Describe how plant structures enable the plant to meet its basic needs	LS-E-A3
4: GLE - 40	Explain the functions of plant structures in relation to their ability to make food through photosynthesis (e.g., roots, leaves, stems, flowers, seeds)	LS-E-A3
4: GLE - 41	Describe how parts of animals' bodies are related to their functions and survival (e.g., wings/flying, webbed feet/swimming)	LS-E-A3

Life Science Organisms and Their Environments

4: GLE - 50	Explain how some organisms in a given habitat compete for the same resources	LS-E-C1
4: GLE - 51	Describe how organisms can modify their environment to meet their needs (e.g., beavers making dams)	LS-E-C1
4: GLE - 52	Describe how some plants and animals have adapted to their habitats	LS-E-C2
4: GLE - 53	Identify the habitat in which selected organisms would most likely live and explain how specific structures help organisms to survive	LS-E-C2

Life Science Populations and Ecosystems

4: GLE - 23	Construct food chains that could be found in ponds, marshes, oceans, forests, or meadows	LS-M-C2
4: GLE - 24	Describe the roles of producers, consumers, and decomposers in a food chain	LS-M-C2
4: GLE - 25	Compare food chains and food webs	LS-M-C2
4: GLE - 26	Identify and describe ecosystems of local importance	LS-M-C3
4: GLE - 27	Compare common traits of organisms within major ecosystems	LS-M-C3
4: GLE - 28	Explain and give examples of predator/prey relationships	LS-M-C4
7: GLE - 24	Analyze food webs to determine energy transfer among organisms	LS-M-C2
7: GLE - 30	Differentiate between structural and behavioral adaptations in a variety of organisms	LS-M-D1

Life Science Adaptations of Organisms

4: GLE - 29	Describe adaptations of plants and animals that enable them to thrive in local and other natural environments	LS-M-D1
7: GLE - 30	Differentiate between structural and behavioral adaptations in a variety of organisms	LS-M-D1
7: GLE - 34	Explain how environmental factors impact the survival of a population	LS-M-D2

Life Science Interdependence of Organisms

10: GLE - 24	Analyze food webs by predicting the impact of the loss or gain of an organism	LS-H-D2

Life Science Systems and Behavior of Organisms

10: GLE - 36	Explain how behavior affects the survival of species	LS-H-F4

Science and the Environment

3: GLE - 57	Describe the interrelationships of *living (biotic)* and *nonliving (abiotic)* components within various ecosystems (e.g., terrarium, swamp, backyard)	SI-E-A1
4: GLE - 71	Describe and explain food chains/webs and the directional flow of energy in various ecosystems (e.g., construct a model, drawing, diagram, graphic organizer)	SE-E-A2
7: GLE - 40	Construct or draw food webs for various ecosystems	SE-M-A5

Science and the Environment Ecological Systems and Interactions

9, 10, 11, 12: GLE - 8	Explain how species in an ecosystem interact and link in a complex web	SE-H-A7 SE-H-A10
9, 10, 11, 12: GLE - 9	Cite and explain examples of organisms' adaptations to environmental pressures over time	SE-H-A8

Profiling the Beach

(or measuring any slope profile) Activity 1-6

Focus/ Overview

This activity uses simple methods to measure changes in elevation such as a beach profile or the slope of any other surface.

Learning Objectives

The Students will . .

- Visit a beach and analyze the beach profile, or measure the profile of any slope in their environment, such as a hill or wheelchair ramp.
- Use simple surveying techniques to create a profile of the beach.
- Analyze the results of their survey and draw conclusions about the profile.
- Conduct research about beach profiles and how and why they change seasonally and through time.

Materials List

- GPS units
- Diagram of beach
- Field tape measure in metric units or a string that measures 2 meters in length.
- 2 surveying stakes (transit rods). These are identical poles about 4 cm (2 inches) square and 3 meters in length with graduations at 2 cm intervals in alternating colored stripes and large numbers, making it easy to read from a distance. You can make these using two rods about 6 to 8 feet in height.
- Note books, pencils, graph paper (large squared easel pads are ideal)

BTNEP Connection
Habitat

Grade Level
9-12 Environmental Science

Duration
2 fifty minute classes

Subject Area
Science or Math

Setting
Beach, hill, or slope

Extension Areas
Art

Vocabulary
Offshore, inshore

Original Source
Berms, dunes, low tide, high tide, water level, foredune, interdune, back dune

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University of New Orleans

- Brunton compass, to obtain sightings in order to locate benchmark at a later date (not needed if a good benchmark is available, or you are doing the activity just once in a location) *(Note: The units used here are metric. If you with to use inches and feet, make sure all units are consistent. It will not affect the end result.)*

Background Information:

Students may see people survey landscapes with many fancy scientific tools but this simple experiment works just fine to measure elevation changes. This historic practice was used in the past.

Advance Preparation:

Prepare copies of Blackline Masters.

Have all measuring materials prepared for students.

Procedure: Creating a Beach Profile

- As a class, observe the profile of the beach. Identify the various components you have learned from previous lessons. (some or all of these may be at your beach site): water level, foreshore, backshore, beach berm, foredune, interdune, back dune.

- If possible, start at the top of a dune, and ask students to make labeled sketches of the profile.
  Have the students work in groups of at least 3 (1 person to hold and sight from the first staff, one to hold the second staff vertical, and one recorder)

1. The first task is to find a permanent object (benchmark) on the beach. This will be your starting point and the point to which you return in the future to repeat the measurements. This might be a concrete object or a fence post that is not going to change location. If nothing is

available you may have to place a benchmark.
A simple benchmark may be placed by hammering a stake deep into
the sand. Be sure it does not become a hazard to people walking on the beach.

2. Take a GPS reading from a telephone pole or stationary permanent object. OR take a sighting with the Brunton Compass from the benchmark to a permanent landmark on the inland horizon.

   Place one stake vertically on the sand at the benchmark. Place the second staff vertically further down the beach, with the two staffs in line with the inland landmark and perpendicular to the shoreline. The distance on the ground between the two staffs is arbitrary, but should be in proportion to the width of the beach (2 meters is good for a narrow beach; 4-8 meters for a wider beach).

3. The person sighting at the first staff chooses a comfortable eye level point on the staff to sight from and calls it to the recorder. This person lines up that point on the first staff with the second staff and the horizon. He or she calls out the number on the second staff that is in line with the horizon.

4. The recorder makes note of the numbers called on the first and second staff and the difference between the two numbers.

5. The recorder, or second recorder, if you have four in a group, makes notes about the ground cover at each point—including the non-living substrate (sand, gravel, shells, etc) and living things (plants).

6. To move to the next point, the first staff holder moves to the position of the second staff holder and the second staff holder measures the correct distance to the next point, sighting by eye to keep the two staffs and the inland landmark in a straight line.

- Repeat steps 6 – 8 until the second staff is at the water line or in the water.

- Using graph paper, draw your profile.

Blackline Masters

Blackline Master 1: Creating a Beach Profile
Blackline Master 2: Illustrating a Beach Profile

Assessments

Assess the students data sheet that measures vertical distance and cumulative vertical distance. Review the graph of the beach profile for accuracy when compared to the data.

Extensions

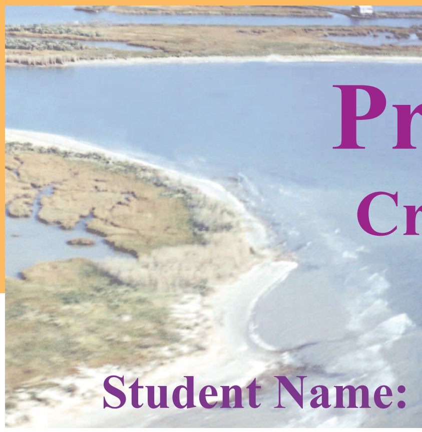
Have students draw a beach profile and then compare it to their calculated slope measurements.

Resources

Beach Profiling Using Emery Board Method
http://www.seagrant.umaine.edu/files/pdf-

http://fcit.usf.edu/florida/teacher/science/mod2/resources/emery.board.pdf

The original reference for Emery beach profiling is:
Emery, K.O., 1961, A simple method of measuring beach profiles: Limnology and Oceanography, v.6, p. 90-93.



Blackline Master 1

Profiling the Beach

Creating a Beach Profile

Activity 1-6

Student Name: ______________________________

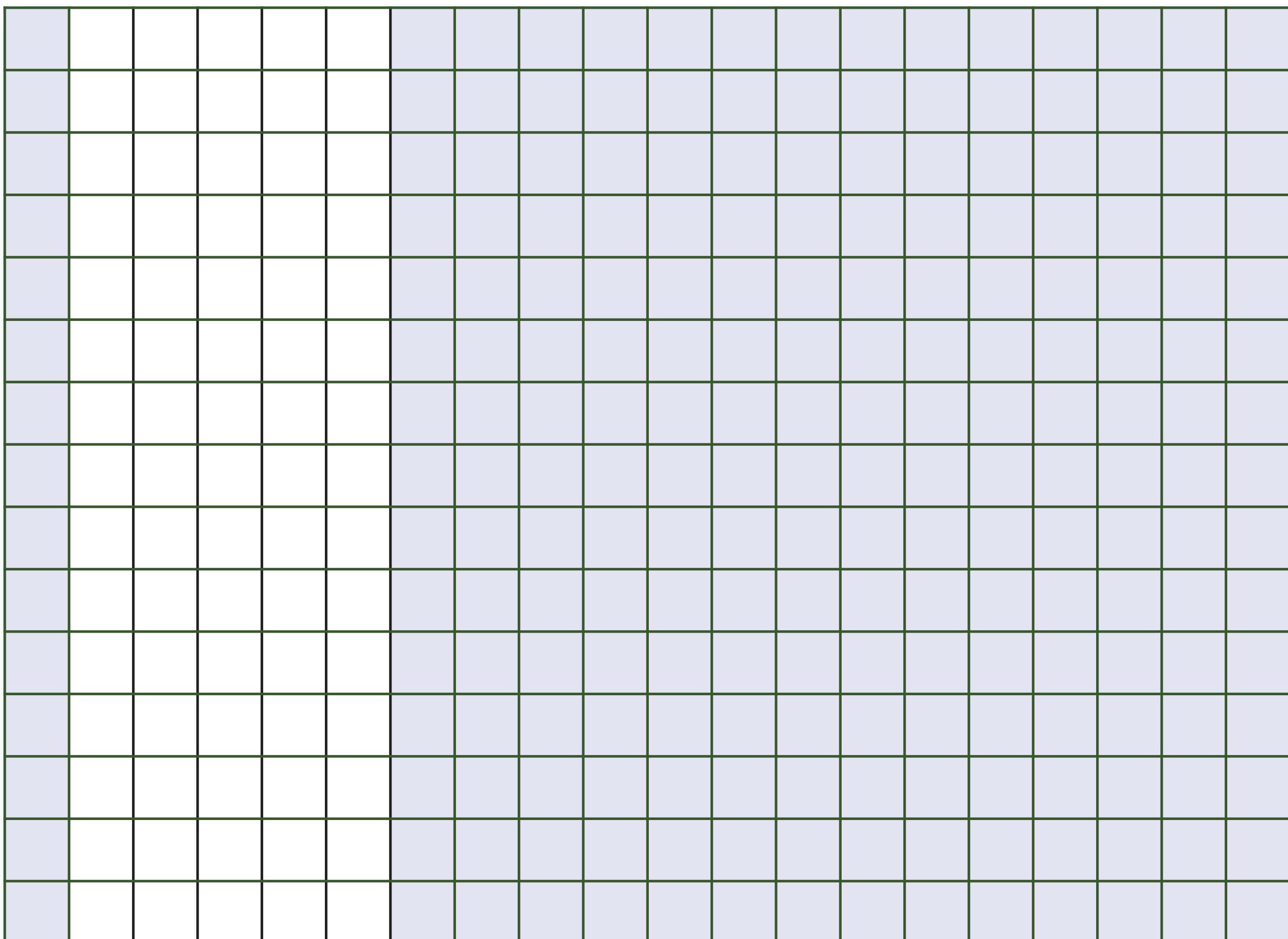
Instructions

Follow the steps to create a beach profile using calculated slope measurements.

Station # ___ Distance between staff 1 and 2 ___ Point on staff 1 ___ Point on staff 2 ___

Difference between 2 points (note negative or positive = up slope or down slope)

Height in centimeters



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Landward Distance in Meters Seaward

Blackline Master 2

Profiling the Beach

Illustrating a Beach Profile

Activity 1-6

Student Name: ______________________________

Instructions

Draw a beach profile and then compare it to your calculated slope measurements

Grade Level Expectations

Lesson Six: Profiling the Beach

or Measuring any Slope

Lesson Six: Profiling the Beach — Math

Data Analysis, Probability, and Discrete Math

4: GLE - 36	Analyze, describe, interpret, and construct various types of charts and graphs using appropriate titles, axis labels, scales, and legends	D-2-E, D-1-E
4: GLE - 37	Determine which type of graph best represents a given set of discrete data	D-2-E, D-1-E
5: GLE - 28	Use various types of charts and graphs, including double bar graphs, to organize, display, and interpret data and discuss patterns verbally and in writing	D-1-M, D-2-M, P-3-M, A-4-M
5: GLE - 29	Compare and contrast different scales and labels for bar and line graphs	D-1-M
5: GLE - 30	Organize and display data using spreadsheets, with technology	D-1-M
5: GLE - 32	Describe data in terms of patterns, clustered data, gaps, and outliers	D-2-M
5: GLE - 33	Analyze discrete and continuous data in real-life applications	D-6-M, D-2-M
6: GLE - 28	Use various types of charts and graphs, including double bar graphs, to organize, display, and interpret data and discuss patterns verbally and in writing	D-1-M, A-4-M, P-3-M, D-2-M
6: GLE - 29	Compare and contrast different scales and labels for bar and line graphs	D-1-M

Data Analysis, Probability, and Discrete Math cont.

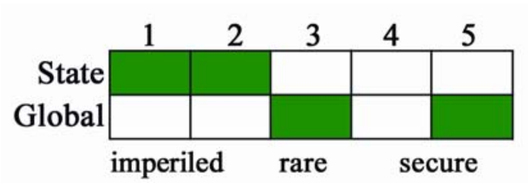
7: GLE - 32	Describe data in terms of patterns, clustered data, gaps, and outliers	D-2-M
7: GLE - 33	Analyze discrete and continuous data in real-life applications	D-6-M D-2-M
8: GLE - 7	Use proportional reasoning to model and solve real-life problems	N-8-M
8: GLE - 34	Determine what kind of data display is appropriate for a given situation	D-1-M
8: GLE - 39	Analyze and make predictions from discovered data patterns	D-2-M

Geometry

9: GLE - 23	Use coordinate methods to solve and interpret problems (e.g., slope as rate of change, intercept as initial value, intersection as common solution, midpoint as equidistant)	G-2-H G-3-H
9: GLE - 24	Graph a line when the slope and a point or when two points are known	G-3-H
9: GLE - 25	Explain slope as a representation of "rate of change"	G-3-H A-1-H

Submergent Vascular Vegetation (Marine & Estuarine)

Rarity Rank: S1S2/G3G5



Synonyms: Submerged Aquatic Vegetation, SAV, Seagrass Bed, Aquatic Bed

Ecological Systems:
CES203.511 Texas-Louisiana Fresh-Oligohaline Subtial Aquatic Vegetation
CES203.263 Northern Gulf of Mexico Seagrass Bed

General Description:

- *Ruppia maritima* (widgeon grass), and *Vallisneria americana* (wild celery) dominate estuarine seagrass beds in Louisiana and waters of the northern Gulf of Mexico, while *Thalassia testudinum* (turtle grass) dominates marine grass beds
- These brackish and salt water communities of rooted "grasses" grow in shallow, protected waters with low turbidity
- Temperature, salinity levels, substrate, wave action, and light penetration are key factors in determining the floral and faunal composition of these beds
- Substrates are generally sand/mud bottoms to a water depth of not greater than 3 to 4 feet
- Small beds occur in ponds scattered throughout marshes of coastal Louisiana, but the most extensive beds are found in the Lake Pontchartrain and Barataria Basins, and in and around the Chandeleur Islands
- SAV beds support a diverse invertebrate and epiphytic population, serve as nursery grounds and shelter for many species of fish and shellfish, and act as important waterfowl feeding areas
- These are highly productive natural communities, releasing detritus and nutrients to surrounding waters
- Seagrass beds help to stabilize near shore substrates, preventing damage and substrate removal by wave action

Sting ray in *Vallisneria* bed

Plant Community Associates

Common species of estuarine seagrass beds include:

Ruppia maritima (widgeon grass)
Vallisneria americana (wild celery)
Najas quadalupensis (southern naiad)
Zannichellia palustris (horned pondweed)
Potamogeton perfoliatus (clasping-leaf pondweed, rare in LA)

Common species of marine seagrass beds include:

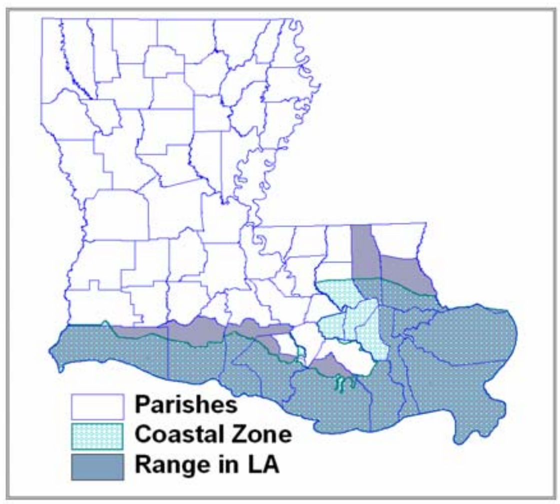
Thalassia testudinum (turtle grass)
Halophila englemanii (sea grass)
Ruppia maritima (widgeon grass)
Cymodocea filiformis (manatee grass)
Halodule beaudettei (shoal grass)

Federally-listed plant & animal species:

Trichechus manatus (manatee)	Endangered; G2; SZN
Chelonia mydas (green sea turtle)	Threatened/Endangered; G3; SZN
Eretmochelys imbricata (hawksbill sea turtle)	Endangered; G3; SZN
Lepidochelys kempii (Kemp's Ridley sea turtle)	Endangered; G1; SZN
Dermochelys coriacea (leatherback sea turtle)	Endangered; G2; SZN
Caretta caretta (loggerhead sea turtle)	Threatened; G3; S1

Range:

Can be found throughout Louisiana's coastal zone marshes and estuaries, however, the last remaining extensive beds are found along the north shore of Lake Pontchartrain and into Lake Maurepas, and in and around the Chandeleur Islands.



LA River Basins:

Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:

- Sea level rise
- Industrial development (oil & gas drilling)
- Hydrological alterations (canal dredging)
- Any activities that increase turbidity and sediment load
- Changes in water quality (increase in salinity levels)
- Construction of pipelines or utilities
- Contamination by chemicals
- Invasive exotic species

Manatee mother and calf
photo: USFWS

Beneficial Management Practices:

- Prevent conversion of existing natural communities to other uses
- Avoid mechanical and water quality impacts in and around seagrass beds
- Avoid activities in shallow waters (less than 4 feet in depth) that might increase disturbance and turbity
- Small volume increase in freshwater inputs to offset salt water influences

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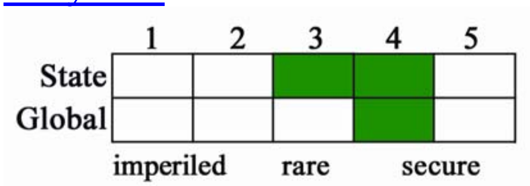
Brackish Marsh


Photo: Todd Baker

Rarity Rank: S3S4/G4?



Synonyms: Needle Rush Marsh, Edge-Zone Marsh, Middle Estuary

Ecological Systems:
CES203.471 Mississippi Delta Salt and Brackish Tidal Marsh
CES203.468 Gulf Coast Chenier Plain Salt and Brackish Tidal Marsh

General Description:

- Usually found between salt marsh and intermediate marsh, although it may occasionally lie adjacent to the Gulf of Mexico
- Experiences irregular tidal flooding and is dominated by salt-tolerant grasses
- Small pools or ponds may be scattered throughout
- Plant diversity and soil organic matter content are higher in brackish marsh than in salt marsh
- Typically dominated by *Spartina patens* (wire grass)
- Two other major autotrophic groups in brackish marsh are epiphytic algae and benthic algae
- Vertebrate species population levels generally higher in brackish marsh compared to salt marsh
- Salinity averages about 8 ppt, and this community may be changed to another marsh types by shifts in salinity levels
- Acts as nursery areas for myriads of larval forms of shrimp, crabs, redfish, seatrout, menhadden, etc., and also as important waterfowl habitat
- Functions as a nitrogen and phosphorus sink, thereby improving the quality of water that passes through this ecosystem
- Can aleviate the effects of storms and flooding by acting as a buffer and providing storage for large amounts of water

Plant Commuity Associates

Common species include:

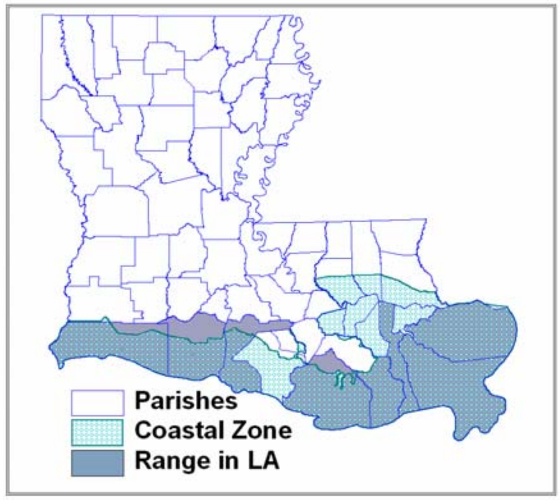
Spartina patens (wire grass)
Schoenoplectus olneyi (three-cornered grass)
Schoenoplectus robustus (salt marsh bulrush)
Paspalum vaginatum (seashore paspalum)
Bacopa monnieri (coastal water hyssop)
Spartina cynosuroides (big cordgrass)
Distichlis spicata (salt grass)
Ruppia maritima (widgeon grass)
Eleocharis parvula (dwarf spikesedge)
Juncus roemanianus (black rush)
Spartina alterniflora (smooth cordgrass)

***Federally-listed plant & animal species*:**

Grus americana (whooping crane)	Endangered; G1; SH
Pelecanus occidentalis (brown pelican)	Endangered (PS:E); G4; S2
Haliaeetus leucocephalus (bald eagle)	Bald & Golden Eagle Protection Act; G4; S2N,S3B

Range:

Presettlement extent of brackish marsh is estimated to have been between 500,000 and 1,000,000 acres with 50 to 75 percent remaining today. At present the total acreage of brackish marsh appears to be increasing due to shifts in marsh salinity levels. However, stable, viable examples of brackish marsh are becoming rare in Louisiana.



LA River Basins:

Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:

- Shoreline erosion and subsidence
- Commercial and industrial development
- Construction of roads, pipelines or utilities
- Hydrological alterations (chanelization and leveeing of waterways, canal dredging)
- Contamination by chemicals or industrial discharge
- Fire suppression
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural communities to other land uses
- Allow natural fires to burn freely (if feasible) and establish regular burning regime on managed lands to improve habitat and food quality for wildlife
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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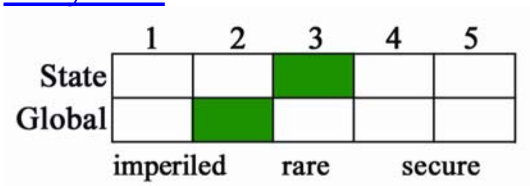
Natural Communities of Louisiana

Coastal Mangrove-Marsh Shrubland

***Rarity Rank*:** S3/G2?



Synonyms: Intertidal Saltwater Swamp, Saltwater Swamp, Mangrove Swamp

***Ecological Systems*:** CES203.471 Mississippi Delta Salt and Brackish Tidal Marsh

General Description:

- Estuarine community generally found adjacent to or surrounded by salt marsh, and often on the leeward side of barrier islands
- Although sometimes termed a swamp, the outward appearance of the community in Louisiana more closely resembles a shrub thicket
- Restricted to Louisiana's outer coastal region due to black mangrove's inability to tolerate freezing temperatures
- Top-kill caused by winter freezes limits mangroves to a shrub-like form (10 feet or less in height), unlike Florida where they attain forest stature
- Extensive root systems stabilize the shoreline and reduce erosion
- Cover and food provided by mangrove shrublands create an excellent nursery area for fish and shellfish
- The presence of mangrove thickets within the salt marsh improves surrounding water quality by filtering nutrients and suspended sediments
- Serves as important nesting areas for colonial waterbirds

Black mangrove seedling

Plant Community Associates

Common species include:

Avicennia germinans (black mangrove)
Spartina alterniflora (smooth cordgrass)
Batis maritima (saltwort)
Salicornia virginica (creeping glasswort)
Iva frutescens (marshelder)
Borrichia frutescens (sea ox-eye)
Distichlis spicata (salt grass)

Avicennia germinans in flower

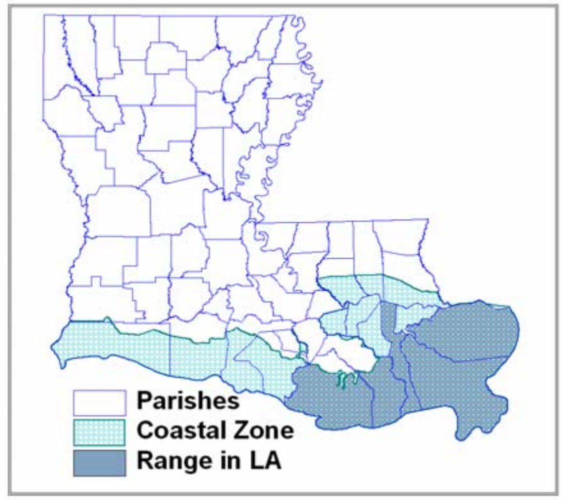
***Federally-listed plant & animal species*:**

Pelecanus occidentalis (brown pelican)
Endangered (PS:E); G4; S2

Natural Communities of Louisiana

Range:

Mangroves in Louisiana are found along the fringes of the Deltaic Plain coastal marshes, most commonly flanking large bays and on the leeward side of barrier islands. It is estimated that in the late 1970's a total of 3,900 to 5,900 acres of mangroves occurred in Louisiana. Occassional hard freezes can seriously reduce the extent of this community in coastal Louisiana. However, mild winters of the past decade have allowed expansion of this natural community in southeastern Louisiana's coastal marshes.



LA River Basins:

Pontchartrain, Barataria, Terrebonne

Threats:

- Shoreline erosion
- Construction of roads, pipelines or utilities
- Hydrological alterations (to include adjacent areas)
- Contamination by chemicals or industrial discharge
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural community to other land uses
- Shoreline or island stabilization
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means


Mangrove invading salt marsh near Port Fourchon


Brown pelicans nesting in mangroves

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Intermediate Marsh

***Rarity Rank*:** S3S4/G4

	1	2	3	4	5
State					
Global					
	imperiled		rare		secure

Synonyms: Oligohaline Marsh

***Ecological Systems*:**
CES203.467 Gulf Coast Chenier Plain Fresh and Oligohaline Tidal Marsh
CES203.470 Mississippi Delta Fresh and Oligohaline Tidal Marsh

General Description:

- This natural community lies between brackish marsh and freshwater marsh, although it infrequently may be adjacent to the Gulf
- Intermediate marsh has an irregular tidal regime and is oligohaline (salinity of 3 to 10 ppt)
- Dominated by narrow-leaved, persistent species particularly *Spartina patens* (wire grass)
- Small pools or ponds may be scattered throughout
- Soil organic matter content is higher than in brackish marsh
- This marsh is characterized by a higher diversity of species than salt or brackish marsh, many of which are found in freshwater marsh and some of which are found in brackish marsh
- Two other major autotrophic groups in intermediate marsh are epiphytic and benthic algae
- Smallest in extent of the four marsh types
- Very important to many species of avian wildlife and supports large numbers of wintering waterfowl
- Also critical nursery habitat to larval marine organisms
- Gradual changes in salinity conditions can cause this habitat to shift towards brackish marsh

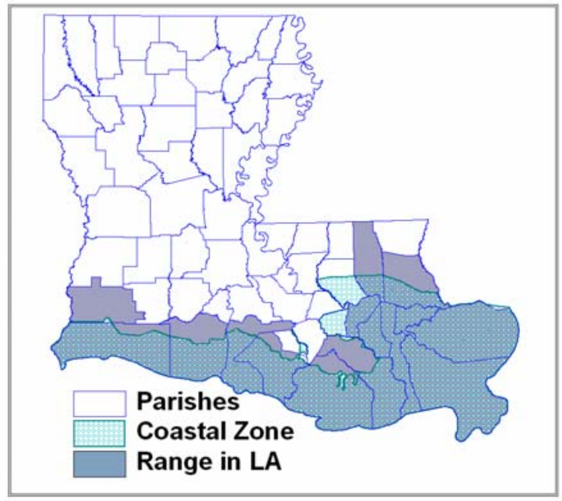
Plant Commuity Associates

Common species include:

Spartina patens (wire grass)
Sagittaria lancifolia (= *S. falcata*; bulltongue)
Eleocharis spp. (spikesedge)
Scirpus californicus (giant bulrush)
Scirpus americanus (common threesquare)
Paspalum vaginatum (seashore paspalum)
Leptochloa fascicularis (bearded sprangletop)
Cyperus odoratus (fragrant flatsedge)
Alternanthora philoxeroides (alligator weed)
Spartina spartineae (gulf cordgrass)
Phragmites communis (roseau cane)
Bacopa monnieri (coastal water hyssop)
Scirpus olneyi (three-cornered grass)
Vigna luteola (deer pea)
Panicum virgatum (switch grass)
Pluchea camphorata (camphor-weed)
Echinonchloa walteri (walter millet)
Najas guadalupensis (southern naiad)
Spartina cynosuroides (big cordgrass)

***Federally-listed plant & animal species*:**
Pelecanus occidentalis (brown pelican) Endangered (PS:E); G4; S2

Range:
Presettlement acreage was estimated at 100,000 to 500,000 acres, but has been reduced by 50 to 75 % of this original extent. The largest contiguous tracts of intermediate marsh occur in Cameron, Vermilion, Terrebonne, and Lafourche parishes.



LA River Basins:
Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:
- Saltwater intrusion and subsidence
- Canal dredging
- Commercial, industrial and residential development
- Construction of roads, pipelines or utilities
- Contamination by chemicals or industrial discharge
- Fire suppression
- Invasive exotic species

Beneficial Management Practices:
- Prevent conversion of existing natural communities to other land uses
- Allow natural fires to burn freely (if feasible) and establish regular burning regime on managed lands to improve habitat and food quality for wildlife
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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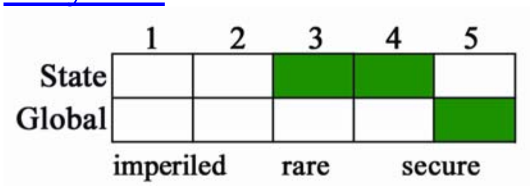
Natural Communities of Louisiana

Salt Marsh

***Rarity Rank*:** S3S4/G5



Synonyms: Smooth Cordgrass Marsh, Saltgrass Marsh, Saline Marsh

***Ecological Systems*:**
CES203.468 Gulf Coast Chenier Plain Salt and Brackish Tidal Marsh
CES203.471 Mississippi Delta Salt and Brackish Tidal Marsh

General Description:

- Generally occurring adjacent to or at the interface of coastal lands with the open waters of the Gulf of Mexico
- Varies in size from 1-15 miles in width
- Small pools or ponds are often scattered throughout
- These marshes are regularly tidally flooded, flat, polyhaline areas dominated by salt-tolerant grasses
- Lowest plant species diversity of any of the four marsh types, and is often totally dominated by *Spartina alterniflora* (smooth cordgrass)
- Lowest soil organic matter content of any marsh type
- Microscopic algae on the surface of vascular plants, and benthic algae (usually diatoms) living on or in the marsh sediment are two other major groups of autotrophs found in salt marsh
- Soil and water conditions regulate plant growth, and salinity appears to be the primary factor determining species composition
- Mean salinity of salt marsh is about 16 ppt
- The area of salt marsh is increasing apparently due to salt-water intrusion resulting in shifts in marsh salinity levels and plant species composition
- Acts as nursery areas for myriads of larval forms of shrimp, crabs, redfish, seatrout, menhadden, etc., and also as important waterfowl habitat
- Functions as a nitrogen and phosphorus sink, thereby improving the quality of water that passes through it
- Can aleviate the effects of storms and flooding by acting as a buffer and providing storage for large amounts of water

Plant Community Associates

Common species include:

Spartina alterniflora (smooth cordgrass)
Distichlis spicata (salt grass)
Batis maritima (salt wort)
Spartina patens (wire grass)
Juncus roemarianus (black rush)

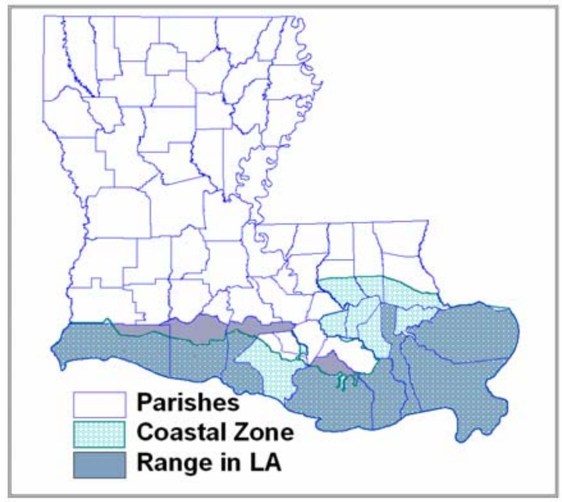
Natural Communities of Louisiana

***Federally-listed plant & animal species*:**

Grus americana (whooping crane)	Endangered; G1; SH
Pelecanus occidentalis (brown pelican)	Endangered (PS:E); G4; S2

Range:

Salt marsh is estimated to have occupied 500,000 to 1,000,000 acres in presettlement times, with an estimated 50 to 75 % remaining. Salt marsh is most common on the deltaic plain of southeast Louisiana.



LA River Basins:

Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:

- Shoreline erosion and subsidence
- Commercial and industrial development
- Construction of roads, pipelines or utilities
- Hydrological alterations (chanelization and leveeing of waterways, canal dredging)
- Contamination by chemicals or industrial discharge
- Fire suppression
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural communities to other land uses
- Allow natural fires to burn freely (if feasible) and establish regular burning regime on managed lands to improve habitat and food quality for wildlife
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- Create new coastal land masses with dredge or other materials where feasible

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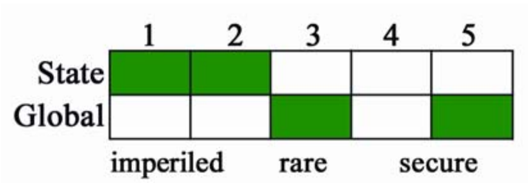
Natural Communities of Louisiana

Submergent Vascular Vegetation (Marine & Estuarine)

Rarity Rank: S1S2/G3G5



Synonyms: Submerged Aquatic Vegetation, SAV, Seagrass Bed, Aquatic Bed

Ecological Systems:
CES203.511 Texas-Louisiana Fresh-Oligohaline Subtial Aquatic Vegetation
CES203.263 Northern Gulf of Mexico Seagrass Bed

General Description:

- *Ruppia maritima* (widgeon grass), and *Vallisneria americana* (wild celery) dominate estuarine seagrass beds in Louisiana and waters of the northern Gulf of Mexico, while *Thalassia testudinum* (turtle grass) dominates marine grass beds
- These brackish and salt water communities of rooted "grasses" grow in shallow, protected waters with low turbidity
- Temperature, salinity levels, substrate, wave action, and light penetration are key factors in determining the floral and faunal composition of these beds
- Substrates are generally sand/mud bottoms to a water depth of not greater than 3 to 4 feet
- Small beds occur in ponds scattered throughout marshes of coastal Louisiana, but the most extensive beds are found in the Lake Pontchartrain and Barataria Basins, and in and around the Chandeleur Islands
- SAV beds support a diverse invertebrate and epiphytic population, serve as nursery grounds and shelter for many species of fish and shellfish, and act as important waterfowl feeding areas
- These are highly productive natural communities, releasing detritus and nutrients to surrounding waters
- Seagrass beds help to stabilize near shore substrates, preventing damage and substrate removal by wave action

Sting ray in *Vallisneria* bed

Plant Community Associates

Common species of estuarine seagrass beds include:

Ruppia maritima (widgeon grass)
Vallisneria americana (wild celery)
Najas quadalupensis (southern naiad)
Zannichellia palustris (horned pondweed)
Potamogeton perfoliatus (clasping-leaf pondweed, rare in LA)

Natural Communities of Louisiana

Common species of marine seagrass beds include:

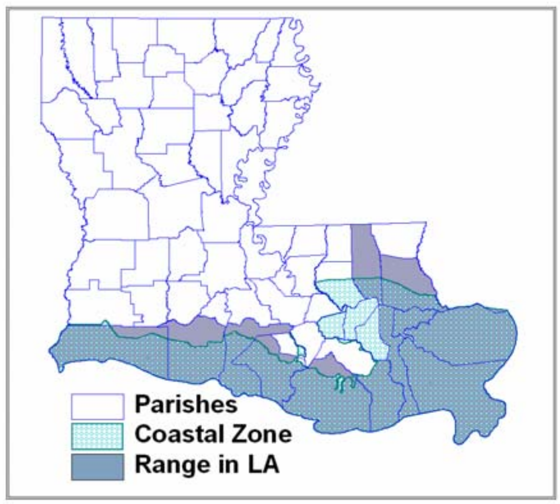
Thalassia testudinum (turtle grass)
Halophila englemanii (sea grass)
Ruppia maritima (widgeon grass)
Cymodocea filiformis (manatee grass)
Halodule beaudettei (shoal grass)

Federally-listed plant & animal species:

Trichechus manatus (manatee)	Endangered; G2; SZN
Chelonia mydas (green sea turtle)	Threatened/Endangered; G3; SZN
Eretmochelys imbricata (hawksbill sea turtle)	Endangered; G3; SZN
Lepidochelys kempii (Kemp's Ridley sea turtle)	Endangered; G1; SZN
Dermochelys coriacea (leatherback sea turtle)	Endangered; G2; SZN
Caretta caretta (loggerhead sea turtle)	Threatened; G3; S1

Range:

Can be found throughout Louisiana's coastal zone marshes and estuaries, however, the last remaining extensive beds are found along the north shore of Lake Pontchartrain and into Lake Maurepas, and in and around the Chandeleur Islands.



LA River Basins:

Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:

- Sea level rise
- Industrial development (oil & gas drilling)
- Hydrological alterations (canal dredging)
- Any activities that increase turbidity and sediment load
- Changes in water quality (increase in salinity levels)
- Construction of pipelines or utilities
- Contamination by chemicals
- Invasive exotic species

Manatee mother and calf
photo: USFWS

Beneficial Management Practices:

- Prevent conversion of existing natural communities to other uses
- Avoid mechanical and water quality impacts in and around seagrass beds
- Avoid activities in shallow waters (less than 4 feet in depth) that might increase disturbance and turbity
- Small volume increase in freshwater inputs to offset salt water influences

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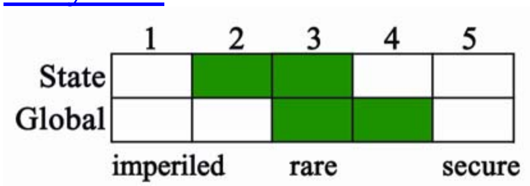
Natural Communities of Louisiana

Vegetated Pioneer Emerging Delta

Rarity Rank: S2S3/G3G4



Synonyms: Delta Flats, Emergent Islands

Ecological Systems: CES203.470
Mississippi Delta Fresh and Oligohaline Tidal Marsh

General Description:

- A dynamic community forming primarily within the actively building delta region at the mouth of the Atchafalaya and Mississippi Rivers
- Soils are formed from course to fine-grained alluvial deposits
- Hydrologic regime ranges from intermittently exposed to intermittently flooded
- Zonation of plant species occurs on the newly accreted land
- Naturally deposited island soils contain a greater percentage of sand and are therefore better drained than marsh soils
- The pioneer ridge vegetation is similar to the sand bars and delta of the Mississippi River while the pioneer marsh vegetation is similar to that of fresh marsh areas
- The pioneer community is successional in nature and changes rapidly with time
- The new delta community's ecological functions are similar in nature to marsh and mudflat systems, serving as nursery grounds for fish and aquatic invetebrate species
- Supports high numbers of wintering waterfowl

Plant Community Associates

Common species dominate on higher elevations include:

Echinochloa walteri (coast cockspur grass)

Common species dominating lower elevation tidally influenced zones include:

Sagittaria latifolia (broadleaf bulltongue)
Sagittaria platyphylla (delta arrowhead)
Leptochloa uninervia (Mexican sprangletop)
Cyperus difformis (variable flatsedge)
Eleocharis parvula (dwarf spikerush)

Common species dominating intermediate zones include:

Sagittaria platyphylla (delta arrowhead)
Cyperus difformis (variable flatsedge)
Bacopa monnieri (coastal water hyssop)
Eleocharis parvula (dwarf spikerush)
Leptochloa fusca ssp. *uninervia* (Mexican sprangletop)

Other common species include:

Salix spp. (willow)
Typha latifolia (common cattail)

Natural Communities of Louisiana

Other common species continued:

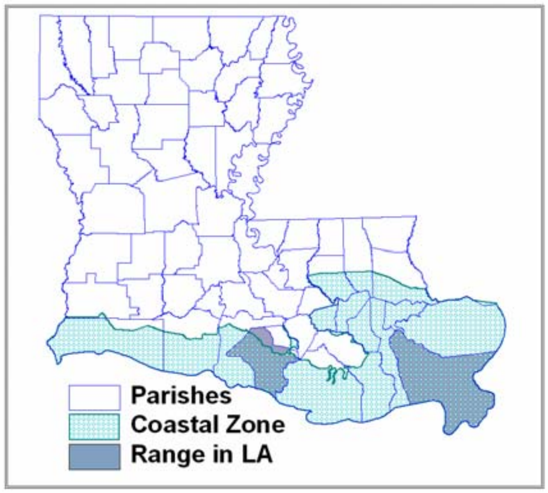
Scirpus validus (softstem bulrush)
Scirpus americanus (threesquare bulrush)
Juncus effusus (soft rush)

***Federally-listed plant & animal species*:**

Pelecanus occidentalis (brown pelican)	Endangered, PS:E; G4; S2
Haliaeetus leucocephalus (bald eagle)	Bald & Golden Eagle Protection Act; G4; S2N, S3B
Trichechus manatus (manatee)	Endangered; G2; SZN
Chelonia mydas (green sea turtle)	Threatented/Endangered; G3; SZN
Eretmochelys imbricata (hawksbill sea turtle)	Endangered; G3; SZN
Lepidochelys kempii (Kemp's Ridley sea turtle)	Endangered; G1; SZN
Dermochelys coriacea (leatherback sea turtle)	Endangered; G2; SZN
Caretta caretta (loggerhead sea turtle)	Threatened; G3; S1

Range:

There are two areas of the Louisiana coast supporting this habitat: the actively forming Atchafalaya Delta and the current mouth of the Mississippi River.



LA River Basins:

Mississippi, Atchafalaya

Threats:

- Channelization and dredging
- Frequent and prolonged fluctuations in river water levels

Beneficial Management Practices:

- Allow natural alluvial deposition processes to continue delta formation
- Identify and protect sensitive areas from disturbances such as boats or other motorized vehicles and recreational use
- Develop better strategies for the placement of dredge materials as a restoration method

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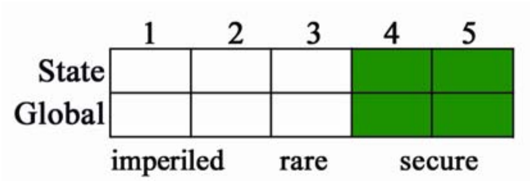
Natural Communities of Louisiana

Batture

***Rarity Rank*:** S4S5/G4G5



Synonyms: Riverfront Pioneer Forest, Cottonwood-Willow Forest, Black Willow Forest, Cottonwood Forest

***Ecological Systems*:**
CES203.190 Mississippi River Riparian Forest
CES203.489 East Gulf Coastal Plain Large River Floodplain Forest
CES203.065 Red River Large Floodplain Forest
CES203.488 West Gulf Coastal Plain Large River Floodplain Forest

General Description:

- Develops on the slope between the natural levee crest and major streams/rivers
- A pioneer community which is first to appear on newly formed sand bars and river margins
- These areas receive sands and silts with each flood
- Soils are semi-permanently inundated or saturated, and inundation or saturation by surface water or groundwater occurs periodically, primarily during spring and summer months
- As river sediments build up, a rapid succession of plant species progresses from willow and cottonwood into bottomland forest types, including the Hackberry-American Elm-Green Ash or Sycamore-Sweetgum-American Elm variations
- The successional sequence is a function of river meander movement rates and point bar formation. Rivers with swift meander movements over unconsolidated sands produce tapered slopes on point bars which are first colonized by the batture community

Plant Community Associates

Primary pioneer tree species include:
Salix nigra (black willow)
Salix exigua (sandbar willow)
Populus deltoides (cottonwood)

Secondary tree species, appearing as succession progresses, include:
Betula nigra (riverbirch)
Platanus occidentalis (American sycamore)
Celtis laevigata (hackberry)
Forestiera acuminata (swamp privet)
Ulmus americana (American elm)
Acer negundo (box elder)
Fraxinus pennsylvanica (green ash)
Carya illinoensis (pecan)
Acer rubrum (red maple)
Planera aquatica (water elm)
Taxodium distichum (baldcypress)
Morus rubra (red mulberry)

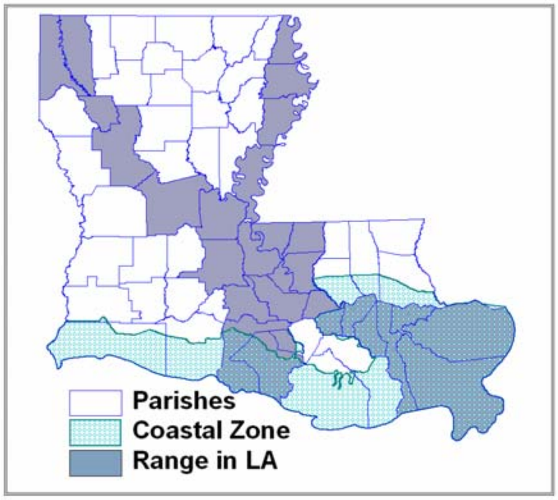
Natural Communities of Louisiana

***Federally-listed plant & animal species*:**

Haliaeetus leucocephalus (bald eagle) — Bald & Golden Eagle Protection Act; G4; S2N, S3B

Range:

Batture occurs primarily along the Mississippi River but also along the Atchafalaya, Red, and perhaps other smaller rivers. It is apparently a secure and viable habitat in Louisiana.



LA River Basins:

Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Red, Ouachita

Threats:

- Operation of drainage or diversion systems
- Hydrological alterations
- Construction of roads, pipelines or utilities
- Invasive exotic species
- Industrial activities and discharge

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Strictly follow Best Management Practices guidelines
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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Bottomland Hardwood Forest

Rarity Rank: S4/G4G5

Synonyms: Mixed Bottomland Hardwoods, Broad Stream Margins, Hardwood Bottoms, Floodplain Forests

Ecological Systems:
CES203.512 Lower Mississippi River Bottomland and Floodplain Forest
CES203.489 East Gulf Coastal Plain Large River Floodplain Forest
CES203.065 Red River Large Floodplain Forest
CES203.488 West Gulf Coastal Plain Large River Floodplain Forest

General Description:

- Forested, alluvial wetlands occupying broad floodplain areas flanking large river systems
- Maintained by a natural hydrologic regime of alternating wet and dry periods that follow seasonal flooding events
- Provide important ecosystem functions including maintenance of water quality, productive habitat for a variety of fish and wildlife species, regulation of flooding, and stream recharge
- Soils are alluvial deposits, heavy clays to silty clays, high in organic matter and nutrients
- Dominant forest species can be aggregated into specific associations based on environmental factors such as physiography, topography, hydric (wet) soils, and hydrologic regimes
- Vegetation associations are typically mixtures of broadleaf deciduous, needleleaf deciduous, and evergreen trees and shrubs

Plant Community Associates

1). Overcup Oak - Water Hickory Bottomland Forest

Quercus lyrata (overcup oak)
Carya aquatica (water hickory)
Fraxinus pennsylvanica (green ash)
Celtis laevigata (hackberry)
Cornus foemina (swamp dogwood)
Forestiera acuminata (swamp privet)
Planera aquatica (planertree)
Cephalanthus occidentalis (buttonbush)
many vine species

2). Hackberry-American Elm-Green Ash Bottomland Forest

Celtis laevigata (hackberry)
Fraxinus pennsylvanica (green ash)
Quercus texana (nuttall oak)
Quercus nigra (water oak)
Liquidambar styraciflua (sweetgum)
Ulmus alata (winged elm)
Gleditsia aquatica (water locust)
Plantanus occidentalis (American sycamore)
Morus rubra (red mulberry)
Ulmus americana (American elm)
Carya aquatica (water hickory)
Quercus phellos (willow oak)
Quercus lyrata (overcup oak)
Acer negundo (box elder)
Acer rubrum (red maple)
Cornus foemina (swamp dogwood)
Crataegus spp. (hawthorn)
many vines and herbaceous species

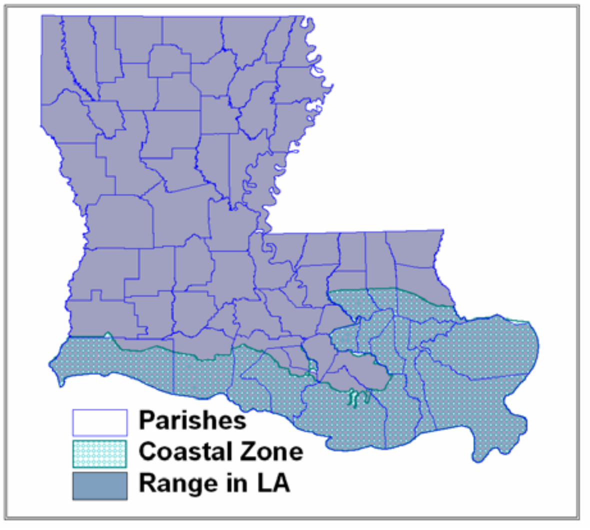
3). Sweetgum-Water Oak Bottomland Forest

Liquidambar styraciflua (sweetgum)
Celtis laevigata (hackberry)
Ulmus americana (American elm)
Acer rubrum (red maple)
Ilex decidua (deciduous holly)
Arundinaria gigantea (switchcane)
Quercus nigra (water oak)
Fraxinus pennsylvanica (green ash)
Quercus pagoda (cherrybark oak)
Sabal minor (dwarf palmetto)
Crataegus viridis (green hawthorn)
many vines and herbaceous species

***Federally-listed plant & animal species*:**
Ursus americanus luteolus (Louisiana black bear) Threatened; G5T2; S2

Range:

Predominant in the Mississippi River Alluvial Plain, but found throughout Louisiana in all river basins. Also important in the East Gulf Coastal Plain in association with major rivers. Bottomland hardwood forest loss is estimated to be 50 to 75 % of the original presettlement acreage. Old-growth examples are very rare.



Threats:

- Clearing for agricultural production was the primary factor leading to fragmentation and decline
- Hydrological alterations
- Construction of roads, utlities and pipelines
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Strictly follow Best Management Practices guidelines
- Maintain natural species composition by following appropriate hardwood management techniques
- No harvesting during wet periods to prevent soil damage
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- No soil disturbance or other activities that alter natural waterflow, including from adjacent areas

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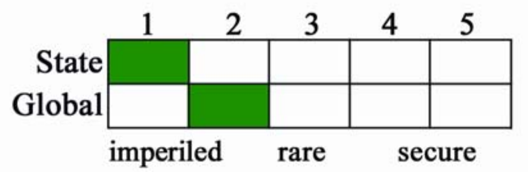
Coastal Prairie

Rarity Rank: S1/G2Q



Synonyms: Cajun Prairie, Great Southwest Prairie, Eastern Coastal Prairie, Gulf Cordgrass Prairie

Ecological Systems:
CES203.550 Texas-Louisiana Coastal Prairie
CES203.541 Texas-Louisiana Coastal Prairie Pondshore
CES203.542 West Gulf Coastal Plain Texas-Louisiana Coastal Prairie Slough

General Description:

- May be divided into two main types, upland dry to mesic prairies at the north portion of its range, and marsh fringing prairie on "islands" or "ridges" in the marsh at the south edge of its range
- The region is underlain by an impervious clay pan 6 to 18 inches below the surface that prevents downward percolation of water and inhibits upward movement of capillary water
- Soils are typically circum-neutral to alkaline, saturated in winter, and often very dry to droughty in late spring and fall
- Historically, trees were confined to the more elevated and better drained stream sides or ridges, forming "gallery forests", and acted to divide the coastal prairie into many subunits or "coves"
- The intrinsic soil conditions and frequent burning from lightening strikes prevented invasion by woody trees and shrubs and maintained the prairie vegetation
- Certain woody species may invade this habitat without periodic fire. The introduced species *Triadica sebifera (=Sapium sebiferum;* Chinese tallow tree) has become especially problematic, forming dense thickets or forests
- The natural demarcation line between the forest and grassland was (and is) very sharp
- Coastal Prairie vegetation is extremely diverse and dominated by grasses
- Many plants in Coastal Prairie also occur in the pine savannahs and flatwoods that occur immediately north of the coastal prairie region

Plant Commuity Associates

Common herbaceous species include:

Paspalum plicatulum (brownseed paspalum)
Schizachyrium scoparium (little bluestem)
Schizachyrium tenerum (slender bluestem)
Andropogon gerardii (big bluestem)
Spartina patens (wire grass, near marshes)
Panicum spp. (panic grasses)
Sporobolus spp. (dropseeds)
Carex spp. (caric sedges)
Rhynchospora spp. (beaked sedges)
Paspalum spp. (paspy grasses)
Aristida spp. (three-awn grasses)
Andropogon spp. (broomsedges)
Eragrostis spp. (love grasses)
Panicum virgatum (switch grass)
Sorghastrum nutans (Indian grass)
Tridens spp. (purple-top)
Cyperus spp. (umbrella sedges)
Scleria spp. (nut-rushes)

Common forb (wildflower) species include:

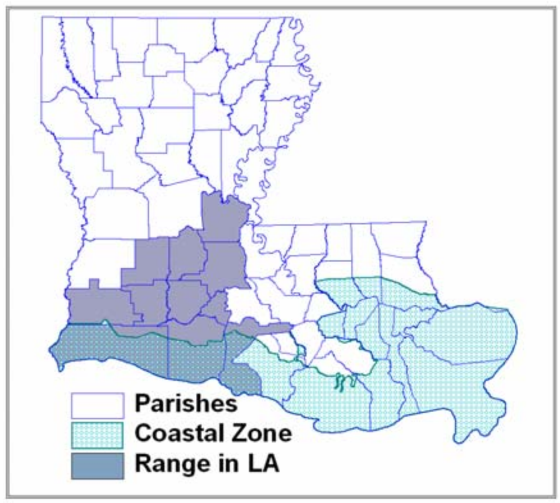
Cacalia ovata (Indian platain)
Liatris spp. (blazing-stars)
Silphium spp. (rosin-weeds)
Baptisia spp. (indigos)
Rudbeckia spp. (brown-eyed susans)
Euthamia spp. (flat-topped goldenrods)
Ruellia humilis (wild petunia)
Coreopsis spp. (tickseeds)
Agalinis spp. (false foxgloves)
Sabatia spp. (rose-gentians)
Aletris spp. (colic-roots)
Helianthus mollis (sunflower)
Asclepias spp. (milkweeds)
Petalostemum spp. (prairie clovers)
Amsonia tabernaemontana (blue star)
Euphorbia spp. (spurges)
Hedyotis nigricans (bluets)
Ludwigia spp. (water primroses)
Solidago spp. (goldenrods)
Eupatorium spp. (thoroughworts)
Polygala spp. (milkworts)
Rhexia spp. (meadow beauties)

Federally-listed plant & animal species:

Grus americana (whooping crane) Endangered; G1; SH

Range:

Remnant Louisiana coastal prairies, once covering an estimated 2.5 million acres, have been reduced to much less than 1 % of the original extent. Only a tiny portion of upland remnant prairies still exist, and they can be found primarily along railroad right-of-ways between railroad tracks and highways. Some of the larger prairie remnants are marsh fringing, wet prairies found in Vermilion and Cameron Parishes.



LA River Basins:

Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:

- Fire suppression
- Invasive exotic species
- Agricultural, industrial and residential development
- Construction of roads, pipelines or utilities
- Saltwater intrusion and subsidence
- Overgrazing

Beneficial Management Practices:

- Prevent conversion of existing natural communities to other land uses
- Use of growing season prescribed fire (April-June) at a frequency of every 1 to 2 years
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- Prohibit livestock grazing

Restored coastal prairie in Eunice, LA

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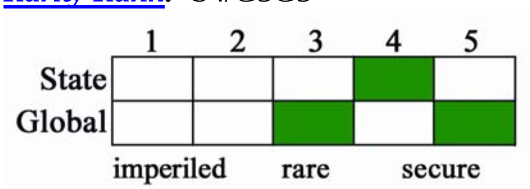
Cypress Swamp & Cypress-Tupelo Swamp

***Rarity Rank*:** S4/G3G5



Synonyms: Freshwater Swamp, Brake, Swamp Forest, Cypress Slough

***Ecological Systems*:**
CES203.490 Lower Mississippi River Bottomland Depression
CES203.065 Red River Large Floodplain Forest
CES203.384 Southern Coastal Plain Nonriverine Basin Swamp
CES203.459 West Gulf Coastal Plain Near Coast Large River Swamp

General Description:

- Forested, alluvial swamps growing on intermittently exposed soils most commonly along rivers and streams but also occuring in backswamp depressions and swales
- Soils are inundated or saturated by surface water or ground water on a nearly permanent basis throughout the growing season except during periods of extreme drought
- All swamps, even deepwater swamps with almost continuous flooding, experience seasonal fluctuations in water levels
- Generally occur on mucks and clays, and also silts and sands with underlying clay layers (Alfisols, Entisols, Histosols, and Inceptisols)
- Relatively low floristic diversity, and associate species may vary widely from site to site
- Undergrowth is often sparse because of low light intensity and long hydroperiod
- Establishment of young trees can only occur during periods of exceptionally long drought, since neither baldcypress nor tupelo gum seeds germinate underwater, nor can young seedlings of these trees survive long submergence
- Swamps tend to be even-aged stands since the environmental conditions favorable for germination and establishment of saplings occur very infrequently, and also baldcypress is an intolerant tree species requiring high light conditions for establishment and successful growth
- Provide important ecosystem functions including maintenance of water quality, productive habitat for a variety of fish and wildlife species, and regulation of flooding and stream recharge

Plant Community Associates

Common overstory tree species include:

Taxodium distichum (baldcypress) *Nyssa aquatica* (tupelo gum)

Common midstory & understory species include:

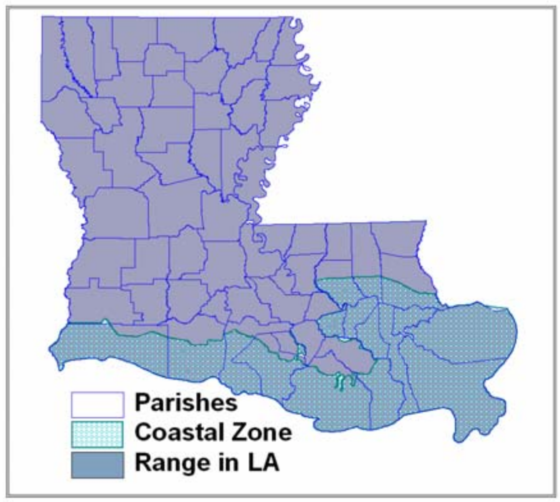
Nyssa biflora (swamp blackgum)
Fraxinus pennsylvanica (green ash)
Acer rubrum var. *drummondii* (swamp red maple)
Gleditsia aquatica (water locust)
Cephalanthus occidentalis (buttonbush)
Fraxinus profunda (pumpkin ash)
Salix nigra (black willow)
Planera aquatica (water elm)
Itea virginica (Virginia willow)

***Federally-listed plant & animal species*:**

Haliaeetus leucocephalus (bald eagle)	Bald & Golden Eagle Protection Act; G4; S2N, S3B
Ursus americanus luteolus (Louisiana black bear)	Threatened; G5T2; S2

Range:

Cypress-tupelo swamps may be found throughout Louisiana in all river basins, and sizeable areas of swamp still remain, even though the historic extent is considerably reduced. Statewide estimates of swamp loss range from 25 to 50 % of the original presettlement acreage and old-growth examples are very rare.



Threats:

- Agricultural, industrial and residential development
- Saltwater intrusion and subsidence
- Hydrological alterations (to include adjacent areas)
- Construction of roads, pipelines or utilities
- Logging on permanently flooded sites where natural or artificial regeneration is not feasible
- Soil damage from timber harvesting or industrial activities
- Contamination by chemicals (herbicides, fertilizers)
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Strictly follow Best Management Practices guidelines
- No logging on permanently flooded sites where natural or artificial regeneration is not feasible
- No logging or heavy equipment use on flooded or saturated soils
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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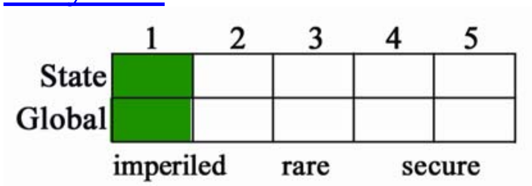
Eastern Longleaf Pine Savannah

***Rarity Rank*:** S1/G1



Synonyms: Pine Savannah, Pine Flatwood, Grass-Sedge Bog, Pitcher-Plant Prairie, Pitcher-Plant Meadow, Pitcher-Plant Bog, Herbaceous Bog, Flatwood Bog

***Ecological Systems*:** CES203.375 East Gulf Coastal Plain Near-Coast Pine Flatwoods

***General Description*:**

- Floristically rich, herb-dominated wetlands with many of the plants closely-allied to hillside bogs
- Sparsely stocked with *Pinus palustris* (longleaf pine) as the dominant tree species
- Occupies the poorly drained and seasonally saturated/flooded depressional areas and low flats
- Commonly associated with mesic pine flatwoods on slight rises and low ridges, often grading down slope to slash pine-pondcypress/hardwood forest, bayhead swamp and/or small stream forest
- Subject to a highly fluctuating water table associated with seasonal hydrologic patterns
- Soils are hydric (wet), very strongly acidic, nutrient poor, fine sandy loams and silt loams, low in organic matter
- Soils may be underlain by an impeding layer slowing water movement in the soil
- Fire maintained natural community (frequent fires prevent woody encroachment and maintain herbaceous layer)

Plant Community Associates

Common woody species include:

Pinus palustris (longleaf pine)
Magnolia virginiana (sweet bay)
Quercus virginiana (live oak)
Quercus laurifolia (laurel oak)
Morella spp. (wax myrtles)
Styrax americana (littleleaf snowbell)
Pinus elliottii (slash pine)
Nyssa biflora (swamp black gum)
Quercus marilandica (blackjack oak)
Cyrilla racemiflora (swamp cyrilla)
Hypericum spp. (St. John's worts)
Taxodium ascendens (pondcypress)

Common herbaceous species include:

Andropogon spp. (broomsedges)
Schizachyrium tenerum (slender bluestem)
Aristida spp. (three-awn grasses)
Muhlenbergia capillaris (hairawn muhly)
Coelorachis spp. (jointgrasses)
Xyris spp. (yellow-eyed grasses)
Scleria spp. (nut-rushes)
Eriocaulon spp. (pipeworts)
Fimbristylis spp. (fimbry-sedge)
Schizachyrium scoparium (little bluestem)
Panicum spp. (panic grasses)
Ctenium aromaticum (toothache grass)
Erianthus spp. (plume-grasses)
Rhynchospora spp. (beak-rushes)
Fuirena spp. (umbrella grasses)
Dichromena latifolia (white top sedge)
Lachnocaulon spp. (bog buttons)

Common forb (wildflower) species include:

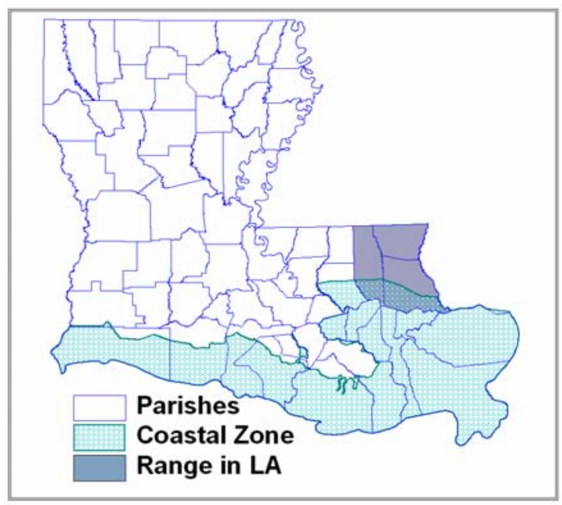
Sarracenia spp. (pitcherplants)
Agalinis spp. (gerardias)
Rhexia spp. (meadow beauties)
Oxypolis filiformis (hog-fennel)
Liatris spp. (blazing-stars)
Drosera spp. (sundews)
Pinguicula lutea (butterwort)
Platanthera spp. (fringed-orchids)
Aletris lutea (yellow colic-root)
sunflower family (Asteraceae)
Cleistes bifaria (spreading pogonia)
Sarracenia psittacina (parrot pitcherplant)
Lobelia spp. (lobelias)
Eryngium integrifolium (bog thistle)
Polygala spp. (milkworts)
Sabatia spp. (rose-gentians)
Pinguicula spp. (butterworts)
Utricularia spp. (bladderworts)
lily family (Liliaceae)
Tofieldia racemosa (coastal false-asphodel)
orchid family (Orchidaceae)
Lycopodium spp. (club-mosses)

***Federally-listed plant & animal species*:**

Picoides borealis (red-cockaded woodpecker) — Endangered; G2; S2

Range:

The eastern Florida Parishes of Louisiana were historically dominated by extensive stands of longleaf pine. Now barely 1 % of the original estimated 100,000 to 500,000 acres of longleaf pine savannahs remains.



LA River Basins:

Pontchartrain, Pearl

Threats:

- Residential or commercial development
- Construction of roads, pipelines or utilities
- Conversion to slash or loblolly pine plantations
- Hydrological alterations (to include adjacent areas)
- Soil damage from timber harvesting and planting activities (eg. bedding)
- Contamination by chemicals (herbicides, fertilizers)
- Fire exclusion or inappropriate fire regime
- Off-road vehicle use
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Use of growing season prescribed fire (April-June) at a frequency of every 1 to 3 years
- No logging during wet periods when the soil is saturated
- Replanting with longleaf seedlings only
- No bedding, plowed fire lines or other soil disturbance that may alter natural water flow patterns
- Prohibit off-road vehicle use, or restrict use to pre-existing trails
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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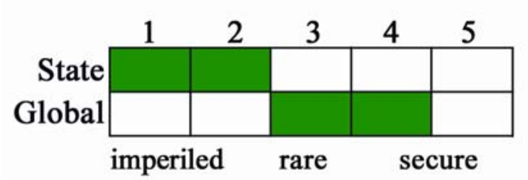
Freshwater Marsh

Rarity Rank: S1S2/G3G4



Synonyms: Fresh Marsh,
Paille Fine (pronounced "pie feen") Marsh

Ecological Systems:
CES203.467 Gulf Coast Chenier Plain Fresh and Oligohaline Tidal Marsh
CES203.470 Mississippi Delta Fresh and Oligohaline Tidal Marsh

General Description:

- Generally located adjacent to intermediate marsh along the northern most extent of the coastal marshes, although it may occur beside coastal bays where freshwater input is entering the bay (e.g., Atchafalaya Bay)
- Small pools or ponds may be scattered throughout
- Floristic composition of these sites is quite heterogeneous and is variable from site to site
- Salinities are usually less than 2 ppt and normally average about 0.5-1 ppt
- Frequency and duration of flooding, which are intimately related to microtopography, seem to be the primary factors governing species distributions
- Substrate, current flow, salinity, competition, and allelopathy are also important in determining species distribution patterns
- Has the greatest plant diversity of any of the marsh types. One report claims 92 plant species in fresh marsh versus only 17 different species in salt marsh
- Has the highest soil organic matter content of any marsh type
- It is frequently dominated by *Panicum hemitomon* (maidencane)
- Epiphytic and benthic algae are two other major autotroph groups in freshwater marsh
- A significant portion of freshwater marsh is floating marsh (flotant), which occurs in the Deltaic Plain of southeast Louisiana
- Wildlife populations are generally highest in this marsh type and it supports high numbers of wintering waterfowl
- Freshwater marsh acts as important nursery areas for the young of many marine species, such as croaker, seatrout, blackdrum, flounder, and juvenile brown and white shrimp
- Saltwater intrusion may cause a change to a more saline marsh type or even open water, if the increase in salinity levels is rapid and persistent

Plant Commuity Associates

Common species include:

Panicum hemitomon (maidencane)
Sagittaria lancifolia (= *S. falcata*)
Alternanthera philoxeroides (alligator weed)
Eleocharis spp. (spikesedge)
Spartina patens (wire grass)
Phragmites communis (roseau cane)

Common species continued:

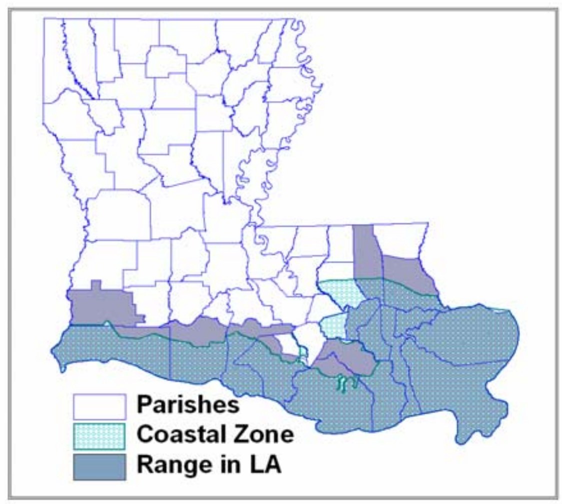
Bacopa monnieri (coastal water hyssop)
Cyperus odoratus (fragrant flatsedge)
Pontederia cordata (pickerelweed)
Hydrocotyle spp. (pennyworts)
Myriophyllum spp. (water milfoils)
Typha spp. (cattail)
Vigna luteola (deer pea)
Ceratophyllum demursum (coontail)
Eichhornia crassipes (water hyacinth)
Peltandra virginica (arrow arum)
Lemna minor (common duckweed)
Nymphaea odorata (white waterlilly)
Utricularia spp. (bladderworts)
Zizaniopsis miliacea (southern wildrice)

Federally-listed plant & animal species:

Grus americana (whooping crane)	Endangered; G1; SH
Haliaeetus leucocephalus (bald eagle)	Bald & Golden Eagle Protection Act; G4; S2N, S3B

Range:

Freshwater marsh has undergone the largest reduction in acreage of any of the marsh types over the past 20 years. Presettlement acreage was estimated at 1 to 2 million acres, but has been reduced by 25 to 50 % of this original extent. The largest contiguous tracts of fresh marsh occur in Terrebonne, St. Mary, Vermillion, Cameron, LaFourche and St. Charles Parishes.

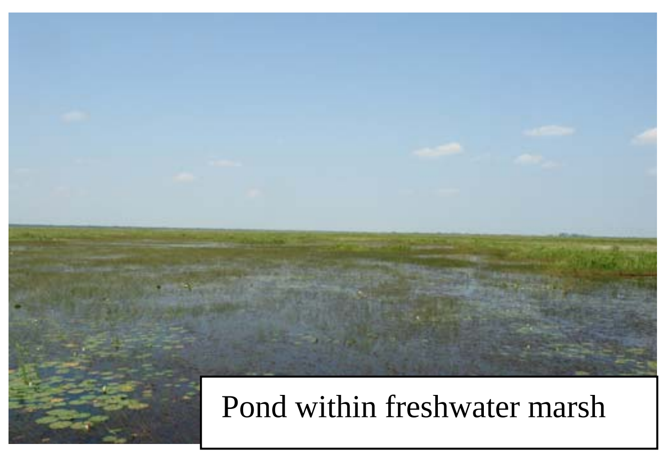


LA River Basins:

Pearl, Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:

- Shoreline erosion and subsidence
- Commercial and industrial development
- Construction of roads, pipelines or utilities
- Hydrological alterations (chanelization and leveeing of waterways, canal dredging)
- Contamination by chemicals or industrial discharge
- Fire suppression
- Invasive exotic species


Pond within freshwater marsh

Beneficial Management Practices:

- Prevent conversion of existing natural communities to other land uses
- Allow natural fires to burn freely (if feasible) and establish regular burning regime on managed lands to improve habitat and food quality for wildlife. Burning should be used only when marshes are flooded to avoid intense heat damage, and never burn in floatant marshes
- Remove any invasive exotic plant species with use of approved herbicides or mechanical means

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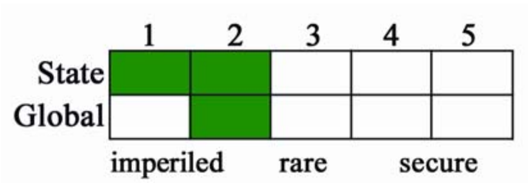
Live Oak Natural Levee Forest

***Rarity Rank*:** S1S2/G2



Synonyms: Natural Levee Forest, Frontland Forest

***Ecological Systems*:**
CES203.512 Lower Mississippi River Bottomland and Floodplain Forest

General Description:
- Occurs principally in southeastern Louisiana on natural levees or frontlands, and on "islands" within marshes and swamps
- Similar in some respects to coastal live oak-hackberry forest in that both develop on natural ridges in the coastal zone and overstory dominants are comparable, however natural levee forests have a greater species richness and diversity
- Composed primarily of sandy loams and clays, these ridges range from 4 to 6 feet above sea level
- Soil pH is circumneutral (6.6 – 7.0), and organic matter content is high
- Important wildlife habitat and serves as vital resting habitat for trans-gulf-migratory birds

Plant Community Associates

Common overstory tree species include:
Quercus virginiana (live oak)
Ulmus americana (American elm)
Acer rubrum (red maple)
Quercus laurifolia (laurel oak)
Liquidambar syraciflua (sweetgum)
Quercus nigra (water oak)
Celtis laevigata (hackberry)
Fraxinus pennsylvanica (green ash)
Gleditsia triacanthos (honey locust)
Acer negundo (box-elder)

Common midstory & understory species include:
Crataegus viridis (green hawthorn)
Morus rubra (red mulberry)
Cornus foemina (swamp dogwood)
Persea borbonia (red bay)
Diospyros virginiana (persimmon)
Sabal minor (dwarf palmetto)
Morella cerifera (wax myrtle)
Viburnum dentatum (arrowwood)

Common herbaceous layer species include:
Tradescantia spp. (spiderworts)
Solidago sempervirens (seaside goldenrod)
Sanicula canadensis (snakeroot)
Arisaema dracontium (green dragon)
Samolus verlandieri (water-pimpernel)
Nemophylla aphylla (baby blue eyes)

Common herbaceous layer species continued:

Geum canadensis (geum)
Eupatorium spp. (thoroughworts)
Polygonum virginica (jumpseed)
Packera glabella (=*Senecio glabellus)* (yellow-top)
Mikania scandens (climbing hempvine)
Cocculus carolinianum (Carolina moonseed)
Berchemia scandens (rattan vine)
Thelypteris spp. (marsh ferns)
Hydrocotyle spp. (penny-worts)
Polygonum spp. (smartweeds)
Panicum spp. (panic grasses)
Oplismenus hirtellus (basket grass)
Campsis radicans (trumpet creeper)
Toxicodendron radicans (poison ivy)
Smilax rotundifolia (greenbrier)

Common epiphytes include:

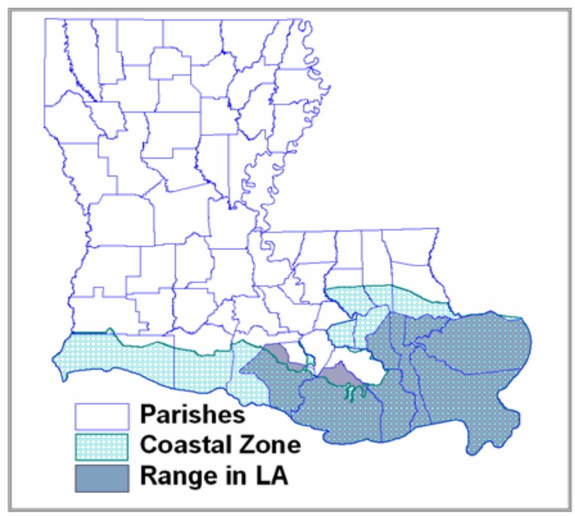
Tillandsia usneoides (Spanish moss)
Polypodium polypodioides (resurrection fern)
Phoradendron tomentosum (mistle-toe)

***Federally-listed plant & animal species*:**

Ursus americanus luteolus (Louisiana black bear) — Threatened; G5T2; S2

Range:

Occur in the Deltaic Plain of extreme southeastern Louisiana parishes from Orleans and St. Bernard Parishes westward to St. Mary Parish. Of the original 500,000 to 1,000,000 acres in Louisiana, currently only 1-5 % of presettlement extent remains.



LA River Basins:

Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche

Threats:

- Residential development
- Roads and utility construction
- Coastal erosion and saltwater intrusion
- Invasive and exotic species
- Overgrazing which damages understory vegetation and inhibits natural stand regeneration

***Beneficial Management Practices*:**

- Prevent conversion of existing natural forests to other land uses
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- Prohibit livestock grazing

Prothonotary warbler (*Protonotaria citrea*) is one of the migratory bird species that utilize coastal natural levee live oak forests.

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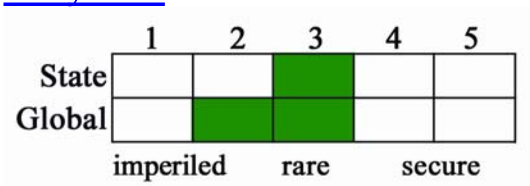
Natural Communities of Louisiana

Pine Flatwoods

***Rarity Rank*:** S3/G2G3



Synonyms: Wet Pine Flatwoods

***Ecological Systems*:** CES203.375 East Gulf Coastal Plain Near-Coast Pine Flatwoods
CES203.557 East Gulf Coastal Plain Southern Loblolly-Hardwood Flatwoods
CES203.191 West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods

General Description:

- Found on the Pleistocene prairie terraces of Louisiana's East and West Gulf Coastal Plains
- Found in a mosaic with other flatwoods, savannahs, and bayhead swamps
- Occur on flat, low-relief areas with a high water table
- Soils are mesic, strongly acidic and fine sandy or silty loams with presence of a clay hardpan
- In Louisiana's Florida Parishes, *Pinus palustris* (longleaf pine) and *Pinus elliottii* (slash pine) are often co-dominants. In southwest Louisiana, only longleaf pine and *Pinus taeda* (loblolly pine) are present
- Fire dependent natural community
- Varies considerably in structure and somewhat in composition from one place to another, as a consequence of minor variations in topography, soil conditions, and hydrologic and fire regimes
- Has a stratified appearance with pine dominating the canopy, a low woody shrub layer, and a herbaceous layer

Plant Community Associates

Common tree species include:

Pinus palustris (longleaf pine)
Pinus elliottii (slash pine, SE LA)
Pinus taeda (loblolly pine)
Pinus glabra (spruce pine, SE LA)
Quercus nigra (water oak)
Quercus laurifolia (laurel oak)
Magnolia virginiana (sweetbay magnolia)
Acer rubrum (red maple)
Liquidambar styraciflua (sweetgum)
Nyssa sylvatica (blackgum)
On wetter sites:
Taxodium distichum (baldcypress)
Taxodium ascendens (pondcypress, SE LA)

Common midstory and understory species include:

Sabal minor (palmetto)
Cyrilla racemiflora (swamp cyrilla)
Ilex coriacea (sweet gallberry)
Ilex glabra (littleleaf gallberry)
Lyonia lucida (fetterbush, SE LA)
Hypericum spp. (St. John's-worts)
Morella cerifera (waxmyrtle)
Clethra alnifolia (summer sweet, SE LA)

Common midstory and understory species continued:

Rubus spp. (blackberries)
Gaylussacia spp. (huckleberries, SE LA)
Vaccinium spp. (blueberries)

Common herbaceous species include:

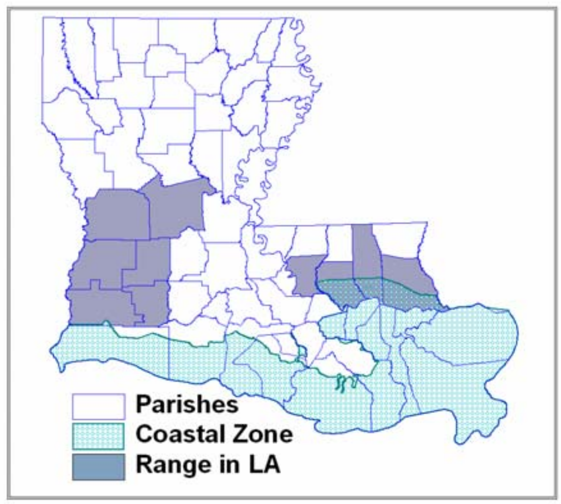
Liatris spp. (blazing-stars)
Chaptalia tomentosa (sunbonnet)
Andropogon spp. (broomsedges)
Panicum spp. (panic grasses)

***Federally-listed plant & animal species*:**

Picoides borealis (red-cockaded woodpecker) — Endangered; G2; S2

Range:

Within Louisiana, found primarily in the Florida Parishes and southwest LA with a few occurrences extending up into central LA



LA River Basins:

Pontchartrain, Pearl, Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:

- Construction of roads, pipelines or utilities
- Conversion to slash or loblolly pine plantations
- Residential or commercial development
- Soil damage from timber harvesting and planting activities (eg. bedding)
- Hydrological alterations (to include adjacent areas)
- Contamination by chemicals (herbicides, fertilizers)
- Off-road vehicle use
- Fire exclusion or inappropriate fire regime
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Use of growing season prescribed fire (April-June) at a frequency of every 5 to 10 years
- No logging during wet periods when the soil is saturated
- No bedding or other soil disturbance that may alter natural water flow patterns
- Prohibit off-road vehicle use, or restrict use to pre-existing trails
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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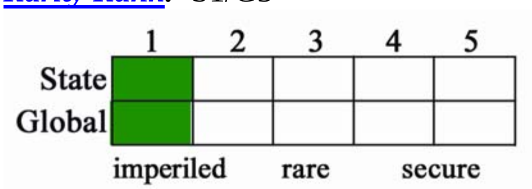
Natural Communities of Louisiana

Pondcypress-Swamp Blackgum Swamp

Rarity Rank: S1/G3



Synonyms: Pondcypress Flooded Woodland

Ecological Systems:
CES203.489 East Gulf Coastal Plain Large River Floodplain Forest

General Description:

- *Taxodium ascendens* (pondcypress), along with *Nyssa biflora* (swamp blackgum) dominate a limited number of swamps making this natural community rare in Louisiana
- Pondcypress/blackgum swamps appear to occupy the backwater portions of larger swamplands, in places much removed from active stream channels
- Related to and often grade into baldcypress swamps more influenced by river flooding
- Soils are inundated or saturated by surface water or ground water on a nearly permanent basis throughout the growing season except during periods of extreme drought
- Subject to seasonal fluctuations in water levels
- Floristic diversity higher than that of traditional cypress swamps or cypress-tupelo swamps
- Herbaceous species may occur as a "flotant" on a fibrous root mat
- Provide important ecosystem functions including maintenance of water quality, productive habitat for a variety of fish and wildlife species, and regulation of flooding and stream recharge

Plant Community Associates

Common overstory tree species include:

Taxodium ascendens (pondcypress)
Nyssa biflora (swamp blackgum)

Common midstory & understory woody species include:

Nyssa sylvatica var. *biflora* (swamp blackgum)
Fraxinus pennsylvanica (green ash)
Acer rubrum var. *drummondii* (swamp red maple)
Gleditsia aquatica (water locust)
Cephalanthus occidentalis (buttonbush)
Fraxinus profunda (pumpkin ash)
Salix nigra (black willow)
Planera aquatica (water elm)
Itea virginica (Virginia willow)
Cyrilla racemiflora (titi)

Common herbaceous species include:

Ludwigia pilosa (hairy primrose-willow)
Carex decomposita (cypress knee sedge, state rare)
Bacopa caroliniana (blue waterhyssop)
Saururus cernuus (lizard's tail)

Common herbaceous species continued:

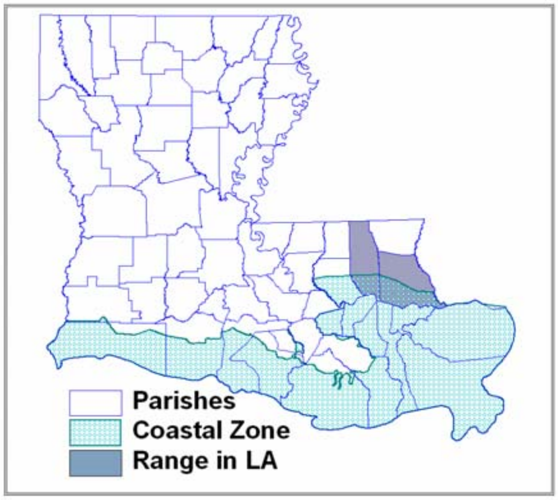
Xyris smalliana (Small's yelloweyed grass)
Lachnanthes caroliana (Carolina redroot)
Triadenum walteri (greater marsh St. Johnswort)
Osmunda regalis var. spectabilis (royal fern)
Andropogon glomeratus (bushy bluestem)
Xyris fimbriata (fringed yelloweyed grass)
Ptilimnium sp. (bishopweed)
Pluchea rosea (rosy camphorweed)
Andropogon glaucopsis (purple bluestem)
Woodwardia areolata (netted chain fern)

Federally-listed plant & animal species:

Haliaeetus leucocephalus (bald eagle) — Bald & Golden Eagle Protection Act; G4; S2N, S3B

Range:

This type seems to be confined to areas along the lower Pearl River, and adjoining north shore of Lake Pontchartrain and Lake Maurepas. The historic extent is unclear, but it is currently only known from one site in Tangipahoa Parish.



LA River Basins:

Pontchartrain, Pearl

Threats:

- Agricultural, industrial and residential development
- Saltwater intrusion and subsidence
- Hydrological alterations (to include adjacent areas)
- Construction of roads, pipelines or utilities
- Logging on permanently flooded sites where natural or artificial regeneration is not feasible
- Soil damage from timber harvesting or industrial activities
- Contamination by chemicals (herbicides, fertilizers)
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- No logging on permanently flooded sites where natural or artificial regeneration is not feasible
- No logging or heavy equipment use on flooded or saturated soils
- Strictly follow Best Management Practices guidelines
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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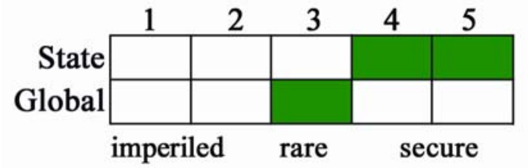
Natural Communities of Louisiana

Scrub/Shrub Swamp

***Rarity Rank*:** S4S5/G3?



Synonyms: Shrub Swamp, Buttonbush Swamp

***Ecological Systems*:** CES203.489 East Gulf Coastal Plain Large River Floodplain Forest
CES203.490 Mississippi River Bottomland Depression
CES203.488 West Gulf Coastal Plain Large River Floodplain Forest
CES203.065 Red River Large Floodplain Forest

General Description:

- A low, flat freshwater swamp with large shrubs and small trees less than 35 feet in height
- This community likely represents a transitional phase of regeneration following disturbance such as cutting or natural blowdown of canopy trees. Additionally, shrubs and trees may be stunted due to some environmental conditions present on the site
- Often associated with newly accreted lands and partially drained wetlands
- Generally occur along sluggish streams and occasionally in semi-permanent pools associated with depressions, old ox bows, and scour channels
- May be found in transition zones between marsh and higher areas such as cheniers
- Soils are often continually flooded, but can become dry during the summer months or during prolonged drought

Plant Community Associates

Common species include:

Cephalanthus occidentalis (buttonbush)
Acer rubrum var. drummondii (swamp red maple)
Baccharis halimifolia (saltbush)
Morella cerifera (waxmyrtle)
Amorpha fruticosa (lead plant)
Forestiera acuminata (swamp privet)
Planera aquatica (water elm)
Salix spp. (willows)
Iva frutescens (marsh-elder)
Sabal minor (palmetto)

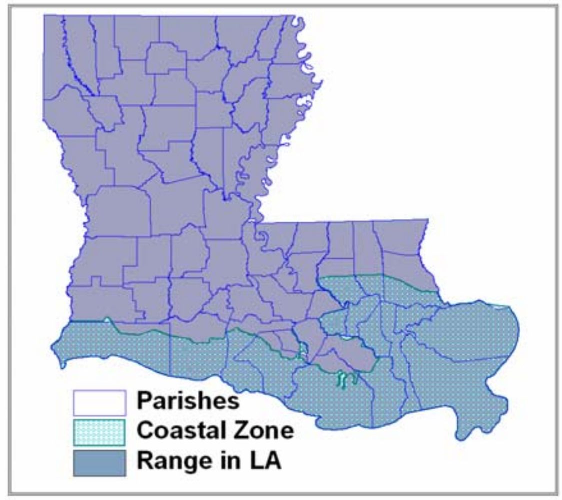
***Federally-listed plant & animal species*:**

None

Natural Communities of Louisiana

Range:

Occurs throughout Louisiana in depressions and bottoms associated with floodplains of rivers and streams



LA River Basins:

Mississippi, Pearl, Pontchartrain, Barataria, Terrebonne, Atchafalaya, Vermilion-Teche, Mermentau, Calcasieu, Sabine, Red, Ouachita

Threats:

- Construction of roads, pipelines or utilities
- Hydrological alterations (to include adjacent areas)
- Contamination by chemicals (herbicides, fertilizers)
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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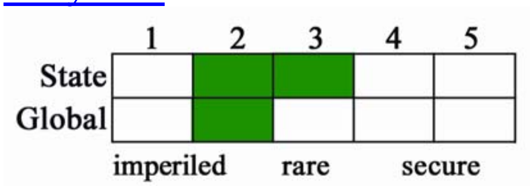
Slash Pine-Pondcypress/Hardwood Forest

***Rarity Rank*:** S2S3/G2?



Synonyms: Wet Slash Pine Flatwoods

***Ecological Systems*:** CES203.375 East Gulf Coastal Plain Near-Coast Pine Flatwoods

General Description:

- Restricted to the wet acidic flatwoods on the far eastern Pleistocene prairie terraces of Louisiana's East Gulf Coastal Plain
- Found in a mosaic with longleaf pine flatwoods and savannahs, and bayhead swamps, existing in a hydrologic/topographic transitional zone between the higher, "drier" longleaf pine flatwood savannahs to the lower, wetter bayhead swamps
- May also be present on broad flats that are partially protected from frequent surface fires by surrounding bayheads or seeps
- Soils are hydric (wet), strongly acidic and nutrient poor silt loams and fine sandy loams
- Two principal soils are Myatt fine sandy loam and Guyton silt loam
- Surface soils are typically saturated for much of the year and shallow water may be present in the late fall/winter/early spring and after rains during the growing season
- Varies considerably in structure and somewhat in composition from one place to another, apparently as a consequence of minor variations in topography, soil conditions, and hydrologic and fire regimes
- Fire dependent natural community; both slash pine and pondcypress are fire-adapted species however, neither is as fire resistant as longleaf pine
- Fire interval is difficult to estimate but is believed to have varied between 5 and 20 years

Plant Community Associates

Common tree species include:

Pinus elliottii (slash pine)
Nyssa biflora (swamp black gum)
Taxodium ascendens (pondcypress)
Magnolia virginiana (sweetbay)

Common understory species include:

Cyrilla racemiflora (swamp cyrilla)
Lyonia lucida (fetterbush)
Itea virginica (Virginia willow)
Morella cerifera (waxmyrtle)
Arundinaria gigantea (switch cane)
Ilex coriacea (sweet gallberry)
Ilex glabra (littleleaf gallberry)
Morella heterophylla (bigleaf waxmyrtle)
Smilax spp. (greenbriers)

Natural Communities of Louisiana

Common ground layer species include:

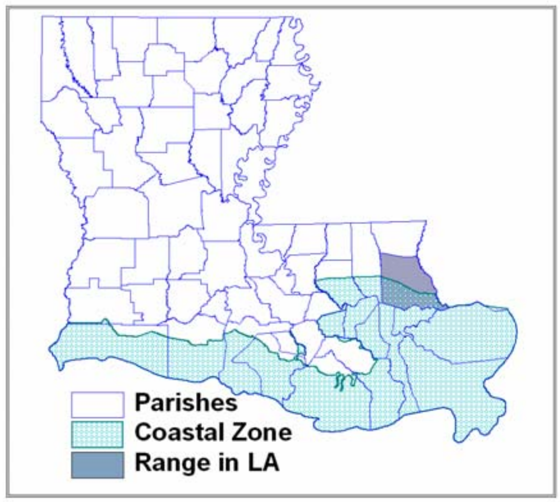
Sphagnum spp. (sphagnum moss)
Pteridophytes (ferns)
minimal herbaceous undergrowth
Scattered, depauperate specimens of herbs, more typical of sunny wet pine savannahs (e.g., *Sarracenia alata*, yellow pitcher-plant), may be observed.

***Federally-listed plant & animal species*:**

Picoides borealis (red-cockaded woodpecker) Endangered; G2; S2

Range:

Presettlement extent of this habitat is estimated at 50,000 to 100,000 acres, with only 10 to 25% currently remaining. Restricted to the East Gulf Coastal Plain; primarily associated with pine flatwoods including eastern longleaf pine savannahs and occassional bogs.



LA River Basins:

Pontchartrain, Pearl

Threats:

- Construction of roads, pipelines or utilities
- Conversion to slash or loblolly pine plantations
- Residential or commercial development
- Soil damage from timber harvesting and planting activities (eg. bedding)
- Hydrological alterations (to include adjacent areas)
- Contamination by chemicals (herbicides, fertilizers)
- Off-road vehicle use
- Fire exclusion or inappropriate fire regime
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Use of growing season prescribed fire (April-June) at a frequency of every 5 to 10 years
- No logging during wet periods when the soil is saturated
- No bedding or other soil disturbance that may alter natural water flow patterns
- Prohibit off-road vehicle use, or restrict use to pre-existing trails
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

Georgia tickseed (*Coreopsis nudata*), rare plant found in slash pine flatwoods and eastern longleaf pine savannahs.

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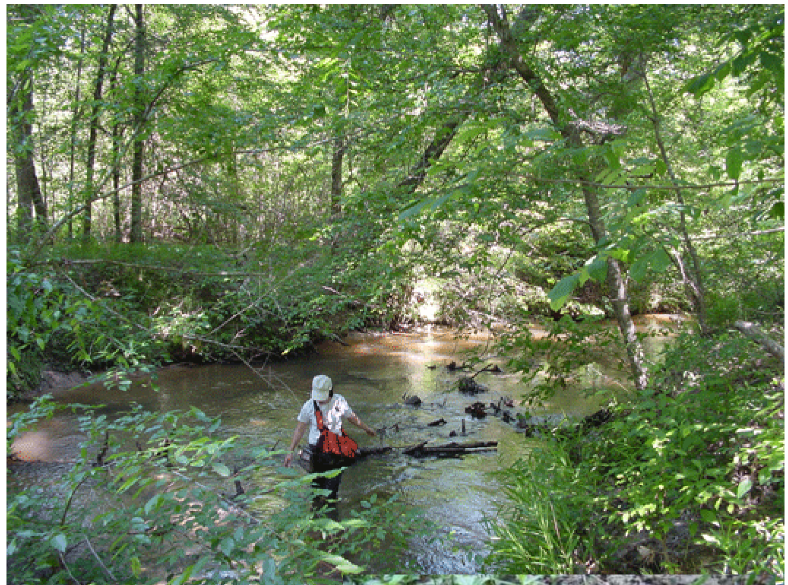
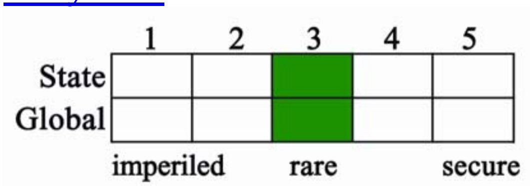
Natural Communities of Louisiana

Small Stream Forest



Rarity Rank: S3/G3



Synonyms: Riparian Forest, Small Stream Floodplain Forest, Creek Bottom Forest, Sandy Branch Bottom, Upland Stream Forest, Hammock

Ecological Systems:
CES203.559 East Gulf Coastal Plain Small Stream and River Forest
CES203.487 West Gulf Coastal Plain Small Stream and River Forest


Isoetes louisianensis

General Description:

- Narrow wetland forests occurring along small rivers and large creeks
- Seasonally flooded for brief periods
- Percentage of sand, silt, calcareous clay, acidic clay, and organic material in the soil is highly variable (depending on local geology) and has a significant effect on plant species composition
- Soils are typically classified as silt-loams
- Quite similar in species composition to hardwood slope forests in some locals
- Critical ecosystem functions include the filtering of surface and subsurface flows, improving water quality, and storing sediment and nutrients

Plant Community Associates

Common overstory tree species include:

Magnolia grandiflora (southern magnolia)
Nyssa sylvatica (blackgum)
Quercus alba (white oak)
Quercus laurifolia (laurel oak)
Liquidambar styraciflua (sweetgum)
Acer rubrum (red maple)
Carya ovata (shagbark hickory)
Fraxinus americana (white ash)
Prunus caroliniana (cherry laurel)
Liriodendron tulipifera (yellow poplar)
Taxodium distichum (baldcypress)
Magnolia virginiana (sweet bay)
Fagus grandifolia (beech)
Quercus michauxii (swamp white oak)
Quercus nigra (water oak)
Quercus pagoda (cherrybark oak)
Platanus occidentalis (sycamore)
Betula nigra (river birch)
Carya cordiformis (bitternut hickory)
Fraxinus caroliniana (water ash)
Ulmus alata (winged elm)
Pinus glabra (spruce pine-FL Parishes)
Pinus taeda (loblolly pine)

Common midstory & understory species include:

Halesia diptera (silverbell)
Viburnum dentatum (arrow-wood)
Symplocos tinctoria (sweetleaf)
Rhododendron canescens (wild azalea)
Carpinus caroliniana (ironwood)
Itea virginica (Virginia willow)
Alnus serrulata (hazel alder)
Styrax grandifolia (bigleaf snowbell)

Florida Parishes - common midstory & understory species include:

Illicium floridanum (starbush)
Cyrilla racemiflora (swamp cyrilla)
Leucothoe axillaris (leucothoe)
Ilex verticillata (winterberry)
Sebastiana fruticosa (sebastian bush)
Lyonia lucida (fetterbush)
Leucothoe racemosa (leucothoe)

Federally-listed plant & animal species:

In East Gulf Coastal Plain occurrences:

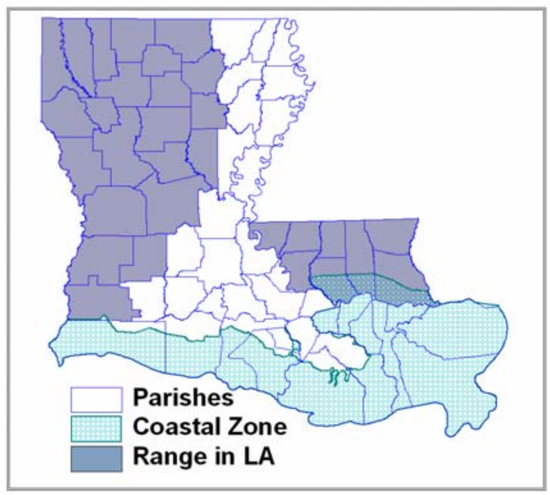
Isoetes louisianensis (Louisiana quillwort)	Endangered; G3; S1
Alosa alabamae (Alabama shad)	Candidate; G3; S1

In Lower West Gulf Coastal Plain occurrences:

Margaritifera hembeli (Louisiana pearlshell)	Threatened; G1; S1

Range:

Found in the Upper and Lower West Gulf Coastal Plains in west, central and northwest Louisiana. Also known from the Florida Parishes in the East Gulf Coastal Plain and Upper East Gulf Coastal Plain



LA River Basins:

Pearl, Pontchartrain, Mississippi, Vermilion-Teche, Mermentau, Calcasieu, Sabine, Red, Ouachita

Threats:

- Habitat conversion
- Gravel mining
- Invasive exotic species
- Construction of roads, utilities and pipelines
- Use of off-road vehicles

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Strictly follow Best Management Practices guidelines
- Maintain natural species composition by following appropriate hardwood management techniques
- No harvesting on steep slopes and during wet periods to prevent soil damage
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- Prohibit off-road vehicle use or restrict use to existing trails
- No soil disturbance or other activities that alter natural waterflow, including from adjacent areas

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Sandbars

Rarity Rank: S4S5/G4

	1	2	3	4	5
State				■	■
Global				■	
	imperiled		rare		secure

Synonyms: River Sandbar

Ecological Systems: CES203.190 Mississippi River Riparian Forest

General Description:

- A sand/gravel deposit in or adjacent to permanently flowing freshwater contained within a natural river channel
- Soils are formed from coarse to fine-textured alluvial deposits
- Plant community structure is dependent on the mix and stability of substrate, severity and depth of flooding, and permanent nature of the particular site
- Hydrologic regime ranges from intermittently exposed to intermittently flooded
- Generally barren, however when present, vegetation is dominated by sparse to dense growth of shrubby or herbaceous species
- The community is successional in nature but generally remains unforested because of repeated flooding
- Due to the early successional nature of sandbars they are easily invaded by exotic plant species
- Serve as critical nesting areas for the federally-endangered interior least tern (*Sterna antillarum athalassos*)

Plant Community Associates

Common overstory tree species include:

Salix nigra (willow)
Populus deltoides (cottonwood)

Common herbaceous species include:

Eragrostis spp. (lovegrass)
Heliotropium procumbens (four-spike heliotrope)
Fimbristylis vahlii (Vahl's fimbry)
Eclipta prostrata (false daisy)
Ludwigia decurrens (winged primrosewillow)
Lindernia dubia (yellowseed false pimpernel)
Sporobolus cryptandrus (sand dropseed,on dry sands)
Croton spp. (goatweed)
Pluchea camphorata (camphor)
Panicum capillare (witchgrass)
Juncus spp. (rushes)
Leucospora multifida (narrowleaf paleseed)
Bergia texana (Texas bergia)

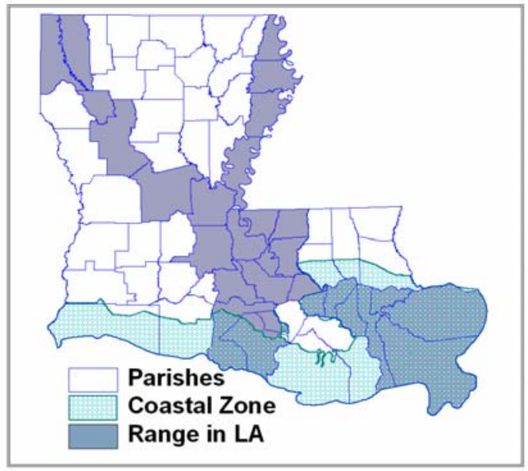
Federally-listed plant & animal species:

Sterna antillarum athalassos (interior least tern) — Endangered; G4T2Q; S1B

Natural Communities of Louisiana

Range:

Found within the channels of major rivers including the Mississippi, Red, and Atchafalaya Rivers. Sandbar habitat within the Mississippi River has shown a general decline over the past 50 years, decreasing by a reported 33 % between Memphis, Tennessee and Baton Rouge, Louisiana from 1948 to 1994.



LA River Basins:

Pontchartrain, Mississippi, Barataria, Terrebonne, Atchafalaya, Red

Threats:

- Channelization
- Frequent and prolonged fluctuations in river water levels
- Gravel mining
- Invasive exotic species
- Construction of roads, utilities and pipelines
- Use of off-road vehicles and other recreational use

Beneficial Management Practices:

- Normalize water levels during tern breeding seasons to prevent inundation of sandbars
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- Prohibit off-road vehicles and other recreational use

Interior least tern nesting, eggs, and chick
Photos: U.S. Fish & Wildlife Service

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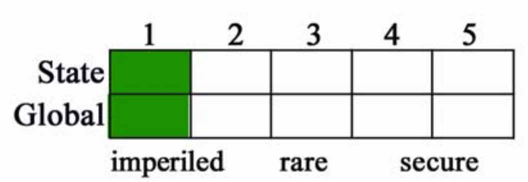
Natural Communities of Louisiana

Barrier Island Live Oak Forest

***Rarity Rank*:** S1/G1



Synonyms: Maritime Forest

***Ecological Systems*:**
CES203.513 Mississippi Delta Maritime Forest

General Description:

- Currently restricted to Grand Isle, Jefferson Parish, Louisiana, where it occupies a small area (less than 1,000 acres)
- Only known occurrence is impacted by development, exotic species, clearing of understory vegetation, and habitat fragmentation
- Appears to be distinct from other *Quercus virginiana* (live oak) communities occurring to the east and west, but little is known about this habitat type
- Trees can exhibit the effects of saltwater spray and wind, having a stunted appearance and leaning away from the prevailing wind

Plant Community Associates

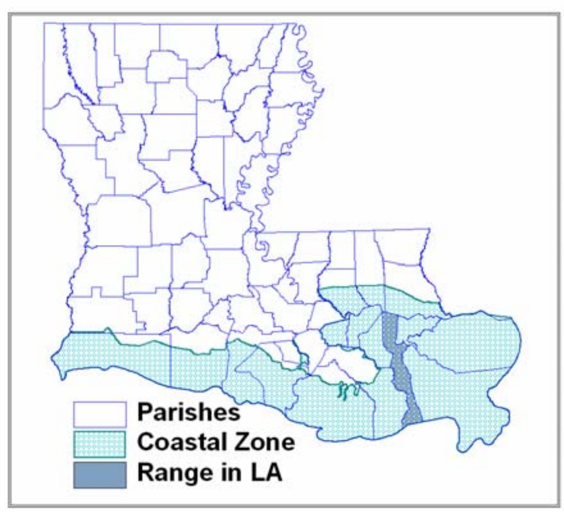
Common woody species include:

Quercus virginiana (live oak)
Zanthoxylum clava-herculis (toothache tree)
Gleditsia triancanthos (honeylocust)
Persea borbonia (red bay)
Celtis laevigata (hackberry)
Diospyros virginiana (persimmon)
Morella cerifera (waxmyrtle)

***Federally-listed plant & animal species*:**
None

Range:

There is no complete information regarding the presettlement extent of this natural community type on Louisiana's barrier islands. The last remaining barrier island live oak forest in Louisiana occurs on Grand Isle.



LA River Basins:

Barataria

Threats:

- Residential or commercial development
- Construction of roads, pipelines or utilities
- Off-road vehicle use
- Invasive or exotic species
- Coastal land loss

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Prohibit off-road vehicle use, or restrict use to pre-existing trails
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- Restoration of coastal land forms such as barrier islands and inland wetlands

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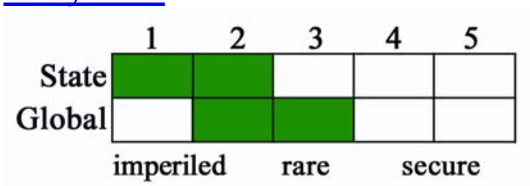
Natural Communities of Louisiana

Coastal Dune Grassland

Rarity Rank: S1S2/G2G3



Synonyms: Maritime Grassland, Dune Meadow, Dune Grass

Ecological Systems:
CES203.469 Louisiana Beach
CES203.471 Southeastern Coastal Plain Interdunal Wetland

General Description:

- Occurs on beach dunes and relatively elevated backshore areas (ridges) above intertidal beaches on barrier islands and on the mainland
- The dunes of Louisiana's barrier islands and mainland beaches are poorly developed because of the high frequency of overwash associated with hurricanes and storms, and a limited amount of eolian-transported sand
- Dune swales may be extensive, and dunes and ridges may be shifted or eroded by storm floods, destroying vegetation
- Normally xeric (excessively drained) due to the sandy substrate and elevation above the highest flood mark (except during hurricanes)
- Vegetative cover ranges from sparse to fairly dense and is dominated by salt spray tolerant grasses
- These sites are exposed to moderate to high amounts of salt spray, have limited nutrient availability, and substrate instability which create harsh conditions for establishment and growth of coastal dune vegetation

Plant Community Associates

Common grasses include:

Spartina patens (wire grass)
Panicum amarum (beach panic)
Paspalum vaginatum (jointgrass)
Schizachyrium maritimum (seacoast bluestem)
Chloris petraea (finger grass)
Eragrostis oxylepis (red lovegrass)
Uniola paniculata (sea oats)
Triplasis purpurea (purple sandgrass)
Distichlis spicata (saltgrass)
Cenchrus spp (sandburs)
Sporobolus virginicus (coast dropseed)
Andropogon spp. (broomsedges)

Common forbs include:

Batis maritima (salt wort)
Ipomea stolonifera (beach morning-glory)
Heliotropium currasivicum (seaside heliotrope)
Agalinis maritima (seaside false foxglove)
Solidago sempervirens (seaside goldenrod)
Hydrocotyle bonariensis (large leaf pennywort)
Iva imbricata (sumpweed)
I. pes-caprae (goat-foot morning-glory)
Strophostyles helvola (sand wild bean)
Cakile spp. (sea rockets)
Croton punctatus (punctate goatweed)
Sabatia stellaris (seastar rose-gentian)

Common forbs continued:

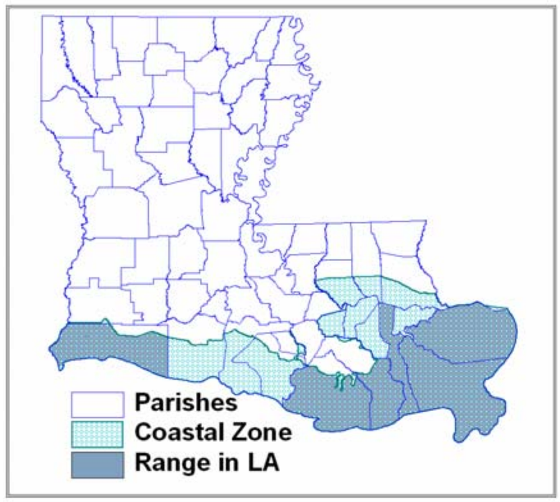
Heterotheca subaxillaris (camphor weed)
Sesuvium portulacastrum (sea purselane)
Aphanostephus skirrobasis (lazy daisy)
Sueda linearis (annual seepweed)
Lippia nodiflora (common frog-fruit)
Atriplex arenaria (quelite)
Pluchea camphorata (camphor-weed)
Salicornia spp. (glassworts)
Centrosema virginianum (butterfly pea)

Federally-listed plant & animal species:

Lepidochelys kempii (Kemp's Ridley sea turtle)	Endangered; G1; SZN
Caretta caretta (loggerhead sea turtle)	Threatened; G3; S1
Pelecanus occidentalis (brown pelican)	Endangered (PS:E); G4; S2

Range:

Coastal dune grasslands are estimated to have occupied less than 2,000 acres in presettlement times, and 50 to 75% was thought to remain prior to the 2005 hurricanes. The most extensive examples of coastal dune grasslands are generally found on Louisiana's barrier islands and the Chenier Plain of southwest Louisiana.



LA River Basins:

Pontchartrain, Mississippi, Barataria, Terrebonne, Mermentau, Calcasieu, Sabine

Threats:

- Shoreline erosion
- Construction of roads, pipelines or utilities
- Contamination by chemicals or industrial discharge
- Off-road vehicle use
- Invasive exotic species
- Overgrazing

Beneficial Management Practices:

- Prevent conversion of existing natural communities to other land uses
- Shoreline or island stabilization
- Prohibit off-road vehicle use
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- Prohibit livestock grazing

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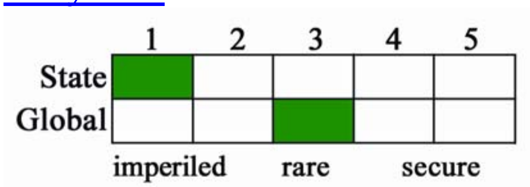
Natural Communities of Louisiana

Coastal Dune Shrub Thicket

***Rarity Rank*:** S1/G3?



Synonyms: Beach dune thicket

***Ecological Systems*:**
CES203.469 Louisiana Beach

General Description:

- Occurs on established sand dunes and beach ridges on barrier islands and the mainland coast
- Very limited extent in Louisiana due to poorly developed coastal dune system
- Sites are typically xeric (dry) to xeric/mesic and moderately exposed to salt spray
- Normally appears as a relatively dense stand of shrubs
- A variety of salt-tolerant shrubs occur, that are often covered with a dense growth of lichens
- May be destroyed by sand dune migration or erosion and may be replaced by Coastal Dune Grassland
- Often serve as important nesting areas for colonial waterbirds

Plant Community Associates

Common species include:

Morella cerifera (wax myrtle)
Iva spp. (marsh elder)
Zanthoxyllum clava-herculis (toothache tree)
Lycium carolinianum (Christmas berry)
Smilax spp. (greenbriers)
Ipomea stolonifera (beach morning-glory)
Ilex vomitoria (yaupon)
Baccharis halimifolia (saltbush)
Acacia smallii (acacia)
Opuntia sp. (prickly pear cactus)
Vitis mustangensis (wild grape)
I. pes-caprae (goat-foot morning-glory)

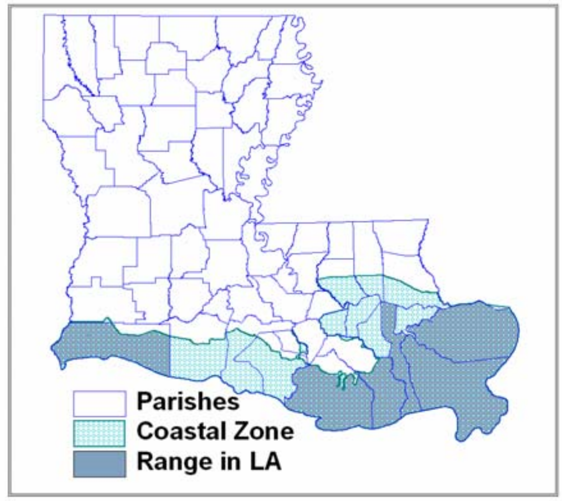
***Federally-listed plant & animal species*:**

Pelecanus occidentalis (brown pelican) — Endangered (PS:E); G4; S2

Natural Communities of Louisiana

Range:

Coastal dune shrub thickets are estimated to have occupied less than 2,000 acres in presettlement times, and 50 to 75% was thought to remain prior to the 2005 hurricanes. The most extensive examples of coastal dune thickets are generally found on Louisiana's barrier islands and the Chenier Plain of southwest Louisiana.



LA River Basins:

Pontchartrain, Mississippi, Barataria, Terrebonne, Mermentau, Calcasieu, Sabine

Threats:

- Shoreline erosion
- Construction of roads, pipelines or utilities
- Contamination by chemicals, industrial discharge, or oil spills
- Off-road vehicle use
- Invasive, exotic species
- Overgrazing

Beneficial Management Practices:

- Prevent conversion of existing natural communities to other land uses
- Shoreline or island stabilization
- Prohibit off-road vehicle use
- Remove any invasive, exotic plant species with use of spot herbicides or mechanical means
- Prohibit livestock grazing

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Natural Communities of Louisiana

Coastal Live Oak-Hackberry Forest

Rarity Rank: S1S2/G2

	1	2	3	4	5
State	■	■			
Global		■			
	imperiled		rare		secure

Synonyms: Cheniere, Maritime Forest

Ecological Systems: CES203.466 West Gulf Coastal Plain Chenier and Upper Texas Coastal Fringe Forest and Woodland

General Description:

- Coastal Live Oak-Hackberry Forest or Cheniere (French for "place of oaks") formed on abandoned beach ridges primarily in southwest Louisiana
- These ancient beaches were stranded via deltaic sedimentation by the constantly shifting Mississippi River
- Composed primarily of fine sandy loams with sand and shell layers or deposits, these ridges range in height from 4 to 5 feet above sea level
- Soils of medium fertility; high permeability
- Serve as important storm barriers limiting saltwater intrusion into freshwater habitats. Typically, marshes north of chenieres are fresher than those gulfward
- Important wildlife habitat and serves as vital resting habitat for trans-gulf-migrating birds

Plant Community Associates:

Common overstory tree species include:

Quercus virginiana (live oak)
Gleditsia triacanthos (honeylocust)
Zanthoxylum clava-herculis (toothache tree)
Salix nigra (black willow)
Celtis laevigata (hackberry or sugarberry)
Ulmus americana (American elm)
Carya illinoensis (sweet pecan)

Common midstory & understory species include:

Crataegus viridis (green hawthorn)
Sabal minor (palmetto)
Sideroxylon lanuginosum (chittim wood)
Cephalanthus occidentalis (buttonbush)
Diospyros virginiana (persimmon)
Ilex decidua (deciduous holly)
Morella cerifera (wax myrtle)
Ilex vomitoria (yaupon)

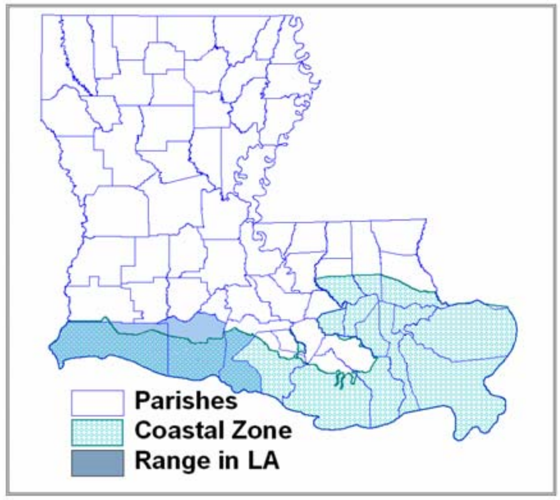
Common herbaceous layer species include:

Opuntia spp. (prickly pear cactus)
Ampelopsis arborea (peppervine)
Toxicodendron radicans (poison ivy)
Parthenocissus quinquefolia (Virginia creeper)
Oplismenus hirtellus (basket grass)
Vitis spp. (wild grape)
Campsis radicans (trumpet creeper)

Common epiphytes include:

Tillandsia usneoides (Spanish moss)
Polypodium polypodioides (resurrection fern)
Phoradendron tomentosum (mistle-toe)

***Federally-listed plant & animal species*:**
None



Range:
Louisiana's coastal chenier forests occur in the Chenier Plain from Iberia Parish westward across Vermilion and Cameron parishes. Of the original 100,000 to 500,000 acres in Louisiana, only 2,000 to 10,000 acres remain, 2-10 % of presettlement extent

LA River Basins:
Vermilion-Teche, Mermentau, Calcasieu, Sabine

Threats:
- Residential development
- Roads and utility construction
- Overgrazing which damages understory vegetation and inhibits natural stand regeneration
- Invasive and exotic species introduction

Beneficial Management Practices:
- Prevent conversion of existing natural forests to other land uses
- Prohibit livestock grazing
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

Magnolia Warbler (*Dendroica magnolia)* is one of the migratory bird species that utilize coastal live oak-hackberry forests

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Natural Communities of Louisiana

Salt Dome Hardwood Forest

Rarity Rank: S1/G1

	1	2	3	4	5
State	■				
Global	■				
	imperiled		rare		secure

Synonyms: None

Ecological Systems: CES203.466 West Gulf Coastal Plain Chenier and Upper Texas Coastal Fringe Forest and Woodland

General Description:

- Restricted to salt domes in coastal Louisiana called the "Five Islands"
- Developed on fertile, circum-neutral to slightly alkaline loessial deposits over salt dome cap rock
- Upland hardwood dominated forest similar to hardwood slope or Southern mesophytic forests
- Highly erodible loess soils that have worn over thousands of years to form a characteristic well-dissected landscape of high, narrow ridges, steep slopes, and deep ravines
- Topographic characteristics of the region create a relatively cool, moist micro-climate on the slopes and in the ravines

Plant Community Associates

Common overstory tree species include:

Quercus virginiana (live oak)
Quercus pagoda (cherrybark oak)
Celtis laevigata (hackberry)
Tilia americana var. caroliniana (basswood)
Carya glabra (pignut hickory)
Magnolia grandiflora (Southern magnolia)
Ulmus americana (American elm)
Liquidambar styraciflua (sweetgum)
Quercus nigra (water oak)

Common midstory & understory species include:

Prunus caroliniana (cherrylaurel)
Sabal minor (dwarf palmetto)
Aesculus pavia (red buckeye)
Parthenocissus quinquefolia (Virginia creeper)
Vitis rotundifolia (muscadine grape)
Ampelopsis arborea (peppervine)
Ilex vomitoria (yaupon)
Callicarpa americana (french mulberry)
Asimina triloba (pawpaw)
Smilax rotundifolia (common greenbriar)
Toxicodendron radicans (poison ivy)
Smilax bona-nox (saw greenbriar)

Common herbaceous layer species include:

Oplismenus hirtellus ssp.*setarius* (bristle basketgrass) *Sanicula canadensis* (black snakeroot)
Malvaviscus arboreus var. *drummondii* (wax mallow) *Rubus* spp. (blackberry)
Elephantopus carolinianus (Carolina elephant's foot)

Common epiphytes include:

Tillandsia usneoides (Spanish moss)

Phoradendron tomentosum (mistle-toe)

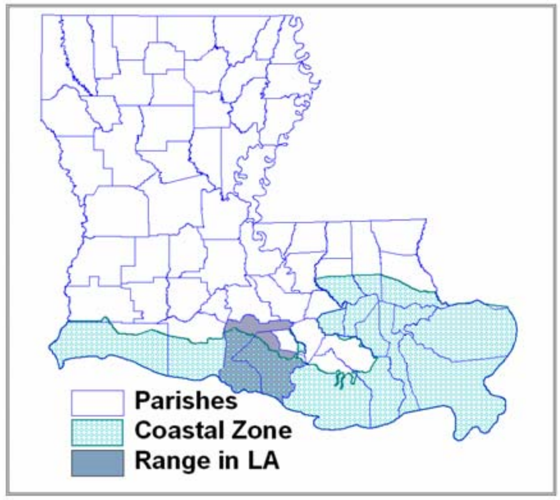
Polypodium polypodioides (resurrection fern)

Federally-listed plant & animal species:

Ursus americanus luteolus (Louisiana black bear) Threatened; G5T2; S2

Range:

Gulf Coast Prairies and Marshes ecoregion in the southwest portions of Louisiana; specifically restricted to the five salt domes, or "islands" of south central Louisiana: Avery, Belle Isle, Cote Blanche, Jefferson, and Weeks Islands.



LA River Basins:

Atchafalaya, Vermilion-Teche

Threats:

- Industrial activities
- Residential development
- Construction of roads, pipelines and utilities
- Invasive exotic species
- Overgrazing

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Maintain natural species composition by following appropriate hardwood management techniques
- No harvesting on steep slopes and during wet periods to prevent soil damage
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means
- Prohibit off-road vehicle use or restrict use to existing trails
- Prohibit livestock grazing

Louisiana black bear

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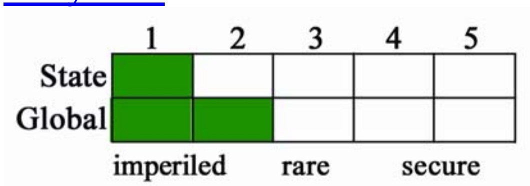
Spruce Pine-Hardwood Flatwood

Rarity Rank: S1/G1G2



Synonyms: Pine-Hardwood Flatwoods

Ecological Systems: CES203.557 East Gulf Coastal Plain Southern Loblolly-Hardwood Flatwoods

General Description:

- Flatwoods type indigenous to the western Florida Parishes of southeast Louisiana
- Wetland variant occupies poorly drained flats, depressional areas and small drainages (sometimes called “slashes”) that lie in a mosaic with higher, non-wetland areas which support a mesic variant
- Both variants are distinguished by the prevalence of *Pinus glabra* (spruce pine) over *Pinus taeda* (loblolly pine), although loblolly is usually present at some level
- Hardwoods usually dominate the forest, but spruce pine can dominate areas within the stand
- Soils are hydric, acidic silt loams including the Encrow, Gilbert and Springfield series
- Soils are significantly higher in nutrient levels than those historically supporting the *Pinus palustris* (longleaf pine) communities occuping similar hydrologic settings immediately to the east
- Fire in these forests is considered very rare as fuel conditions are not conducive to fire and the component plant species are not fire adapted

Plant Community Associates of Wet Hardwood Flatwoods

Common overstory tree species include:

Pinus glabra (spruce pine)
Acer rubrum (red maple)
Fraxinus caroliniana (Carolina ash)
Fagus grandifolia (American beech)
Nyssa biflora (swamp blackgum)
Quercus laurifolia (laurel oak)
Quercus nigra (water oak)
Quercus phellos (willow oak)
Pinus taeda (loblolly pine)
Carya glabra (pignut hickory)
Fraxinus pennsylvanica (green ash)
Magnolia grandiflora (Southern magnolia)
Nyssa sylvatica (blackgum)
Quercus michauxii (swamp chestnut oak)
Quercus pagoda (cherrybark oak)
Liquidambar styraciflua (sweetgum)

Common midstory & understory species include:

Cephalanthus occidentalis (buttonbush)
Crataegus opaca (mayhaw)
Cornus foemina (swamp dogwood)
Arundinaria gigantea (switchcane)

Natural Communities of Louisiana

Common midstory & understory species continued:

Diospyros virginiana (persimmon)
Ilex opaca (American holly)
Morella cerifera (wax myrtle)
Sambucus canadensis (elderberry)
Styrax americanus (snowbell)
Vitis rotundifolia (muscadine)
Berchemia scandens (rattan vine)
Campsis radicans (trumpet creeper)
Ilex decidua (deciduous holly)
Itea virginica (Virginia willow)
Toxicodendron radicans (poison ivy)
Smilax spp. (greenbriars)
Viburnum dentatum (arrowwood)
Ampelopsis arborea (peppervine)
Brunnichia cirrhosa (ladies' eardrops)
Sabal minor (dwarf palmetto)

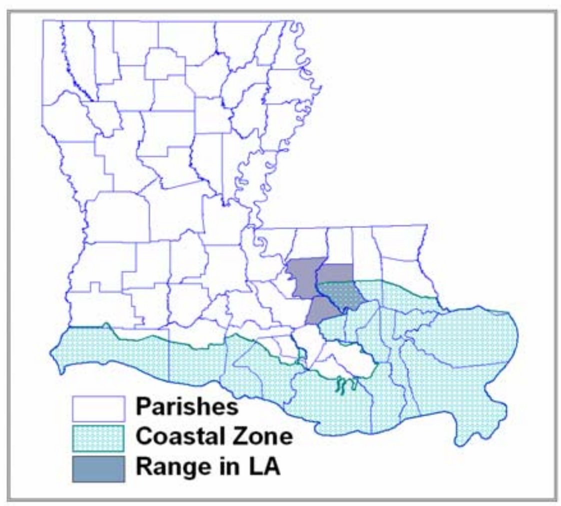
Common herbaceous & fern species include:

Boehmeria cylindrica (hempweed)
Chasmanthium spp. (spikegrasses)
Hypericum spp. (St. Andrew's cross)
Justicia ovata (waterwillow)
Onoclea sensibilis (sensitive fern)
Polygonum spp. (smartweed)
Panicum gymnocarpon (savannah panicgrass)
Thelypteris palustris (Southern shield fern)
Triadenum walteri (greater marsh St. John's wort)
Carex spp. (sedges)
Cyperus spp. (flatsedges)
Juncus spp. (rushes)
Ludwigia spp. (primrose willow)
Osmunda regalis (royal fern)
Rhynchospora spp. (beaksedge)
Saururus cernuus (lizard's tail)
Woodwardia areolata (netted chain fern)
Vernonia gigantea ssp. *gigantea* (ironweed)

***Federally-listed plant & animal species*:** None

Range:

Occurs in a very narrow range in Livingston, East Baton Rouge and perhaps Ascension Parishes. Presettlement acreage is estimated at 50,000 to 100,000 acres with only 10 % currently remaining.



LA River Basins:

Pontchartrain, Mississippi

Threats:

- Residential or commercial development
- Construction of roads, pipelines or utilities
- Conversion to slash or loblolly pine plantations
- Hydrological alterations (to include adjacent areas)
- Invasive exotic species

Beneficial Management Practices:

- Prevent conversion of existing natural forests to other land uses
- Maintain natural species composition by following appropriate hardwood management techniques
- No harvesting during wet periods to prevent soil damage
- No bedding or other soil disturbance that may alter natural water flow patterns
- Remove any invasive exotic plant species with use of spot herbicides or mechanical means

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Appendix

Barrier Islands

Focus/ Overview

Natural Communities of Louisiana Field Guide

This guide is to be used as a reference to the Barrier Island Lessons