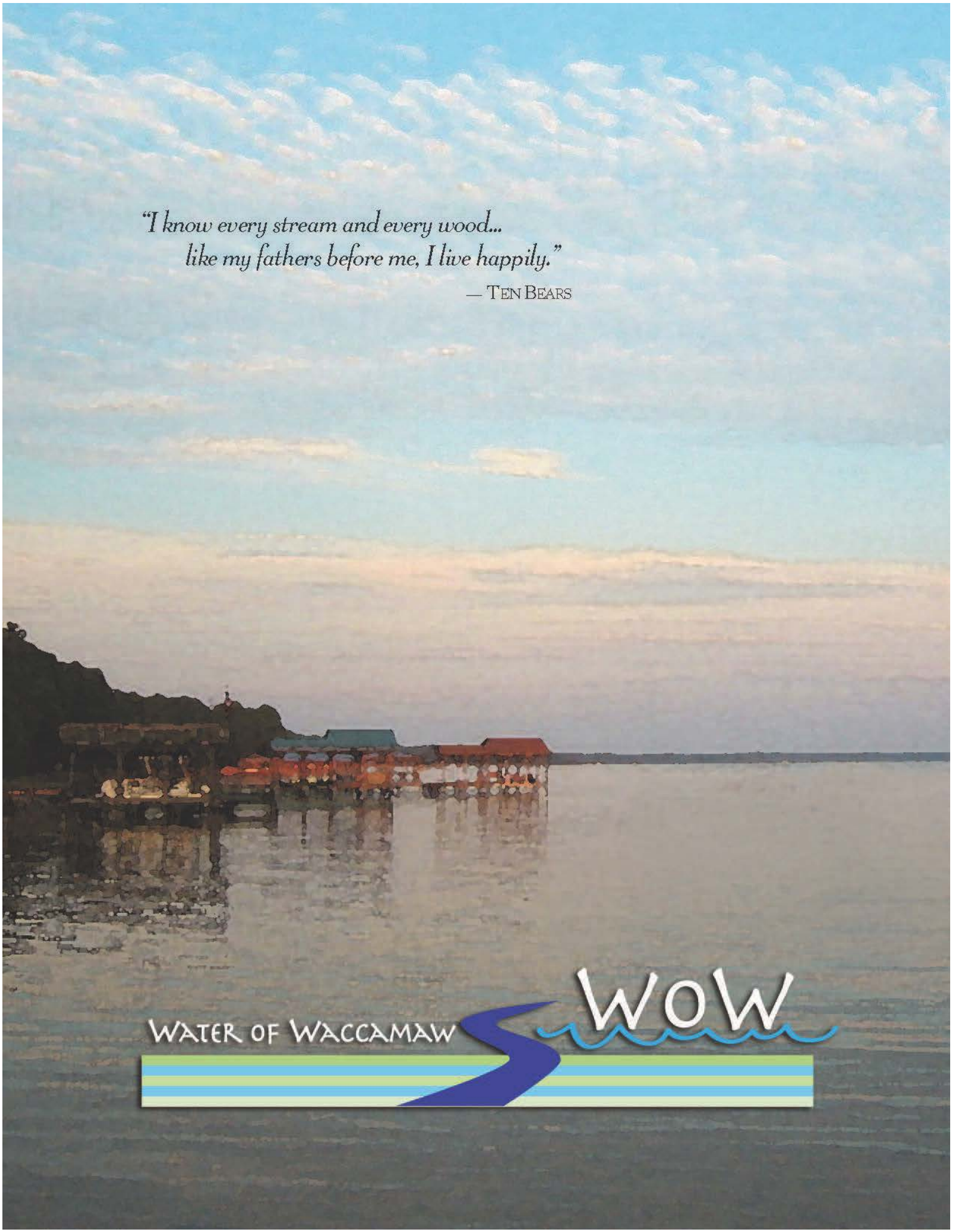

"I know every stream and every wood...
like my fathers before me, I live happily."
— Ten Bears
Water of Waccamaw
WOW

Back of COVER PAGE

INTRODUCTION TO THE WATERS OF WACCAMAW TEACHER'S GUIDE

Dear Teachers,

This guide is intended to provide enrichment to your courses in History, Science, Math, Social Studies for eighth grade through high school. It provides a local context for students to study our natural and cultural environment. We hope it instills a sense of pride in students to be part of such a unique community as the Waccamaw watershed, in North Carolina. Each chapter of the guide can be used individually; and ideas for activities and ways to tie it to the NC curriculum are provided. We hope that you use your creativity to develop new activities and ways to use this guide.

The Waters of Waccamaw Guide is an attempt to help connect children to their natural environment. Exposure to natural landscapes has been shown to improve physical and mental health. Numerous studies have shown that exposure of children to nature can be a form of therapy for attention-deficit disorders and other mental ailments.[1] Just as children need good nutrition and sleep, they also need exercise and contact with nature.

Environmental education can play a significant role in addressing these needs. We know barriers to environmental education include limits on number of field trips, transportation costs, and the lack of material tailored to the particular, local environment of the students. This guide is tailored to the students of the Waccamaw River Watershed and can be used in middle and high schools throughout Brunswick and Columbus Counties. You can use it in your own classroom or schoolyard, and of course field trips are encouraged.

The Waters of Waccamaw Teachers' Guide was funded by a Ribbon of Hope grant from the GlaxoSmithKline Foundation. We would love to hear feedback from you about this Teachers' Guide, and any ideas you develop. Thank you for using this guide.

Sincerely,

NC Coastal Land Trust
131 Racine Drive, Suite 202
Wilmington, NC 28403

TABLE OF CONTENTS

"This country is mine, I was raised on it;
my forefathers died on it; and I wish to remain on it."

— CROW FEATHER

a. The Original People of Lake Waccamaw

Curriculum Ties: 8th Grade Social Studies Objective 1.02

Native Americans

Before European settlers arrived at Lake Waccamaw, it was home to native American Indians. A site called Indian Mounds is located on the east shore of Lake Waccamaw. Indian Cheiftain, Osceola, was born on Lake Waccamaw and his statue is on exhibition in the City of Washington. He was one of the Waccamaw Siouan Indians. In 1971, the Waccamaw Siouan Indians, the main Waccamaw tribe, was recognized as one of eight tribal nations in North Carolina. They were recognized by the state in 1971 and are located in Bladen and Columbus counties. The Waccamaw Siouans now have 1,245 members and a homeland located on the edge of the Green Swamp. Historians believe the tribe was first met by settlers during a Spanish expedition in 1521.[2]

European Settlers

King Charles II granted much of the land in the Waccamaw watershed to settlers willing to make a living in the new world. These large land holdings were then divided among heirs and new settlers, and by the mid-1700's very few of the original settlers or descendants were still living around the lake.

In 1852, Josiah Maultsby mapped out streets, lots, a commons and a public square on Lake Waccamaw, called the Village of Flemington. The Village of Flemington grew slowly until the coming of the Wilmington-Manchester Railroad and by 1869 Flemington had a post office and a hotel.[3]

Lake Waccamaw attracted large numbers of summer visitors, and with the demand on naval stores and turpentine, the railroad served an important role in the development of this area for timber. Naval stores are products used in shipbuilding. Two shingle companies resided in Lake Waccamaw, which later became the NC Lumber Company. Cypress shingles were shipped across the lake on flat boats, unloaded onto the NC Lumber Company pier, and transported by a mule-drawn rail car to the Lake Waccamaw depot for shipment by freight train. Flemington was incorporated as the Town of Lake Waccamaw in 1911. The town hosted over 1,000 visitors annually around the 4th of July celebration. Over time, a boardwalk was built, along with a 600 foot pier, a covered pavilion with diving boards, slides, and a bathhouse for changing.[4]

Links for Further Research:

- **The History of Lake Waccamaw (pdf)**
- **Waccamaw Storybook (pdf)**

Activity Ideas:

- **Visit the Lake Waccamaw Depot Museum (www.lakewaccamawdepotmuseum.com)**
- **Class creates their own "Story of the Waccamaw".**

Tree Swing by Dale Suiter

HISTORY

b. The Mysterious Community of Crusoe Island

Curriculum Ties: 8th Grade Social Studies Objectives 7.02 & 7.03

Crusoe Island is located in the Green Swamp and has been an isolated community for the last couple of centuries. Historically, the residents of Crusoe Island were farmers and hunters. There have been many speculations about the origin of the community, including:

- They were Europeans and Indians driven inland from the coast;
- They were early settlers driven in from the coast by pirates;
- They were pirates seeking refuge from authorities after raiding coastal towns;
- They were survivors of the Lost Colony.

Charles Patton wrote a fictional book*, Crouisilleau*, based on historical information. Mr. Patton's theory is that the residents of Crusoe Island are descendants of French settlers who left Haiti during the slave revolutions and settled in the area around 1790. Crusoe residents have been associated with a unique English dialect that distinguishes it from other regional and social dialects of the North Carolina Southeastern Coast.[5] A dialect is a variety of language that differs because of where one lives.

Excerpts from an article in the New York Herald Tribune, November 1, 1931:

> "*In three continents where they sell the product of a factory that he helped to found, the recent death of Kinchen D. Council was regretted. In Crusoe's Island, NC where none of the tools made in his nearby factory was ever needed, men and women wept and looked backward over two decades through which he had been their untiring friend. Neither tool making nor bear hunting nor ancient literature was his passion. His great love was for historical research in obscure places. Twenty years ago where few people venture into the wilderness that lay along the Waccamaw River, he came upon old man Buck Clewis and a clue to an historical mystery that provided him hobby until his death.*
>
> *Twenty years ago it was a country to be avoided. It abounded with all sorts of wild game, especially bear and deer. But also abounded a strange people with whom it was thought best to have little to do. They lived almost wholly in*

and by the swamps. People from the uplands dreaded any encounter with them. Since the beginning of the colony, the Waccamaw Swamp country was supposedly the receptacle of fugitives who could not maintain themselves decently in established settlements. The swamp people were without schools or churches or any formal civilization. No good had ever gone into the colony, the people round about said, and no good ever came out of it.

Mr. Council, was an inveterate bear hunter, and he was possessed of an insatiable curiosity about people. He decided to venture into the swamp in pursuit of a bear and was gone even longer than he had planned. When he came back he brought the skin of a vast bear and a face that glowed with secret satisfaction. Deep in the swamp where his hounds were howling after the bear, Mr. Council had encountered Buck Clewis. There in the swamp a friendship was born, and at the next Board of Commissioners meeting he declared that a school ought to be provided for the people of Crusoe's Island." [6]

Council Tool Shop 1900

Links for Further Research:

- **Crusoe Island: One Way In, One Way Out Video (http://www.youtube.com/watch?v=t9-CNNlBpH0)**
- **The New York Herald Tribune Article Nov 1, 1931 (pdf)**

Activity Ideas:

- **Tour Crusoe Island with a local community resident and write a report on a subject of choice.**
- **Interview the Owner of Council Tools and record an oral history about Kinchen Council.**

HISTORY

c. Geology Rocks!

Curriculum Ties: 8th Grade Science Objective 2.03

Southeastern North Carolina and northeastern South Carolina stretch across the lower Coastal Plain and are strongly influenced by the geologic region called the “Cape Fear Arch”. It is simply described as an uplift of sand and limestone rock deposits located between Cape Lookout in North Carolina and Cape Romain in South Carolina. Limestone is a rock formed from the skeletons and shells of ocean organisms. It extends inland beyond Fayetteville to the Sandhills Region of the Carolinas. The Waccamaw watershed is located within the Cape Fear Arch.

The Cape Fear Arch is a little higher in elevation than areas to the north and south, and has been above sea level for a longer period of time, standing as a peninsula when the rest of the coastal plain was under water. Elevation means the height of land, usually

measured from sea level. These factors helped to produce a unique set of habitats, on which evolved rare species found nowhere else in the world, like the Venus flytrap. Habitat is the environment in which a plant or animal lives. As with the plants and animals some of their habitats have also been identified as among the most threatened in North America. [7] Threatened means to be in danger.

Links for Further Research:

- **Cape Fear Arch Website (www.capefeararch.org)**
- **Cape Fear Arch Slideshow (pdf)**

Activity Ideas:

- **Tour Southeastern Community College's Venus Flytrap Propagation Project.**
- **Visit the Cape Fear Arch Website and create your own slideshow about a species or habitat of choice.**

Waccamaw Lily by Dale Suiter

HISTORY

d. "Wacky" Lake Waccamaw

Curriculum Ties: 8th Grade Language Arts Objective 1.02

Lake Waccamaw is a natural freshwater lake measuring 5 miles by 3.5 miles with an average depth of 7.5 feet. The center of the lake bottom is covered in peat, comprising about 30% while the margins are covered in sand, comprising the remaining 70%. Peat is a type of soil consisting of partially decomposed organic debris, usually saturated with water. The lake is fed by underground springs and four creeks: First Little Creek, Second Little Creek, Third Little Creek and Big Creek. The lake flows over a small dam built in 1926, and empties into the Waccamaw River.[8] The Waccamaw River then flows into South Carolina, where it flows into Winyah Bay and then into the Atlantic Ocean near the City of Georgetown, SC.

Lake Waccamaw is the largest of the natural Carolina Bay Lakes in North Carolina, with a surface area around 9,000 acres. The term “Carolina Bay” comes from the abundance of bay trees growing in swampy places on the Carolina coastal plain. Lake Waccamaw is estimated to be 15,000 to 30,000 years old. Older fossils have been found in and around the lake, including a whale skull dating 1-3 million years old. [9] Many explanations have been offered about the formation of Carolina Bays, including Lake Waccamaw. From meteors to natural limestone erosion, from ancient fish to fires, none have been proven true. Erosion is the process by which the earth's surface is worn away. The most widely accepted theory is the simple action of waves and wind carving out the shape of the Carolina Bays. Lake Waccamaw is unique because underneath the lake are limestone deposits, which neutralize the acidic waters to create a near neutral pH. This ideal water quality has created aquatic animals found nowhere else on earth.

On surrounding lands, lightening strikes historically have ignited fires and maintained longleaf pine forests. Native Americans were the first to use fire to intentionally improve the habitat for game, visibility through the forest and insect control. European settlers of the southern Coastal Plain continued to use burning to maintain longleaf forests for grazing and game. The open forest also provided easy access to the valuable naval stores from the trees (tar, pitch, turpentine, and timber). Logging of the Southern forests began in the late 1800s and by 1930 most of the longleaf forest acreage was harvested around Lake Waccamaw.

Links for Further Research:

- **Skull-Diggery, Exploring Waccamaw Top to Bottom (pdf)**
- **Excerpts from Voyage of the Paper Canoe. 1878 by Nathaniel Bishop (pdf)**

Activity Ideas:

- **Read the Voyage of the Paper Canoe and research one of the communities visited by the author.**
- **Visit Lake Waccamaw State Park to view the Whale Skull.**

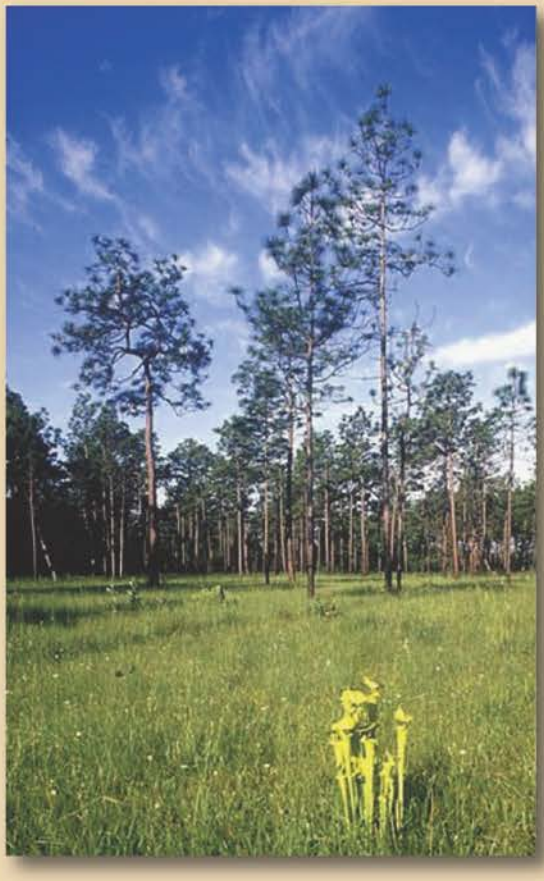
Lake Waccamaw by Intracoastal Realty

Venus flytrap by Dale Suiter

HISTORY

Notes and Thoughts

CHAPTER 2: The Waccamaw Watershed



"I love the land... the trees which cover it,
the water flowing over it, the grass growing on it."

— COMO

a. What is a Watershed?

Curriculum Ties: 8th Grade Science Objectives 1.04 & 1.05

A watershed is the area of land where water drains into a particular stream, river or lake. The Lake Waccamaw watershed is part of the larger Lumber River watershed in North Carolina and South Carolina. The Lumber River is situated along the state border at the southeast corner of NC. The Lumber River flows from the Sandhills Region in North Carolina to the Pee Dee River in South Carolina. The Pee Dee River empties into the Atlantic Ocean at Winyah Bay in South Carolina near Myrtle Beach. The Lumber River watershed includes Lake Waccamaw, a unique Carolina Bay. Lake Waccamaw, the Waccamaw River and associated floodplains are the key features of this teachers' guide.

Eight species of animals are found only in the lake or associated waters including the Waccamaw Silverside (*Menidia extensia*), Carolina pygmy sunfish (*Elassoma boehlkei*), and the Waccamaw fatmucket (*Lampsilis fullerkati*), a freshwater mollusk. The Upper Waccamaw River Swamp consists of the most extensive cypress-gum swamp in the state and contains habitat for the endemic Cape Fear Threetooth snail (*Triodopsis soelneri*). In addition, the Waccamaw River provides high quality aquatic habitat for the Waccamaw crayfish (*Procambarus braswelli*) and numerous freshwater mussels. Endemic is an organism that is found only within a particular area. Lay's Lake is a manmade lake near the Waccamaw River with islands of cypress trees near the South Carolina border. A large colony of nesting great blue herons, anhingas, cattle egrets, little blue herons, and wood storks is found there. [10]

Due to the ecological significance of the watershed, many areas around Lake Waccamaw are protected by the State of NC and non-profit organizations. The State Division of Parks and Recreation owns and manages the Lake Waccamaw State Park. The State Wildlife Resources Commission owns and manages land along the river and on the northeast side of Lake Waccamaw. These lands are known as the Columbus County

Game Lands. Both The Nature Conservancy and the N.C. Coastal Land Trust have also protected land along the Waccamaw River.

Links for Further Research:

- **2010 Lumber River Basinwide Water Quality Management Plan (pdf)**
- **Columbus County Gamelands (pdf)**

Activity Ideas:

- **Select a species of interest, find a photograph and interesting facts about it.**
- **List all the human activities that may harm water quality in a watershed**

Aerial Photograph of Lake Waccamaw

THE WACCAMAW WATERSHED

b. The Many Uses of the Waccamaw Watershed

Curriculum Ties: High School AP Earth & Environmental Science Objective 7.04

The Waccamaw River watershed covers approximately 804,000 acres of land. The Waccamaw watershed is the least populated area within the larger Lumber River watershed. The Waccamaw River and Lake Waccamaw are considered pristine. Urban development is not widespread and much of the watershed remains forested, either naturally or as pine plantations.[11]

As we use the Waccamaw watershed for homes, businesses, and recreation, there are things we can do to protect it. A few are discussed below.

Areas beside rivers and lakes that have plants and trees can be used to "buffer" the water from harmful chemicals and provide wildlife habitat. River and lake buffers are an effective way to prevent threats to aquatic animals and plants. Buffers provide a wide range of benefits including:

- Trapping and removing sediments, phosphorus, and pesticides.
- Reducing erosion, and storing floodwaters
- Maintaining habitat for aquatic animals by providing wood, shade, nesting and feeding areas.

Land Use Planning in a community can be a way to keep important natural places alongside business and homes. A county or town can create a Land Use Plan that includes guidelines for designing nature-friendly communities. Creating a Land Use Plan consists of 6 steps:

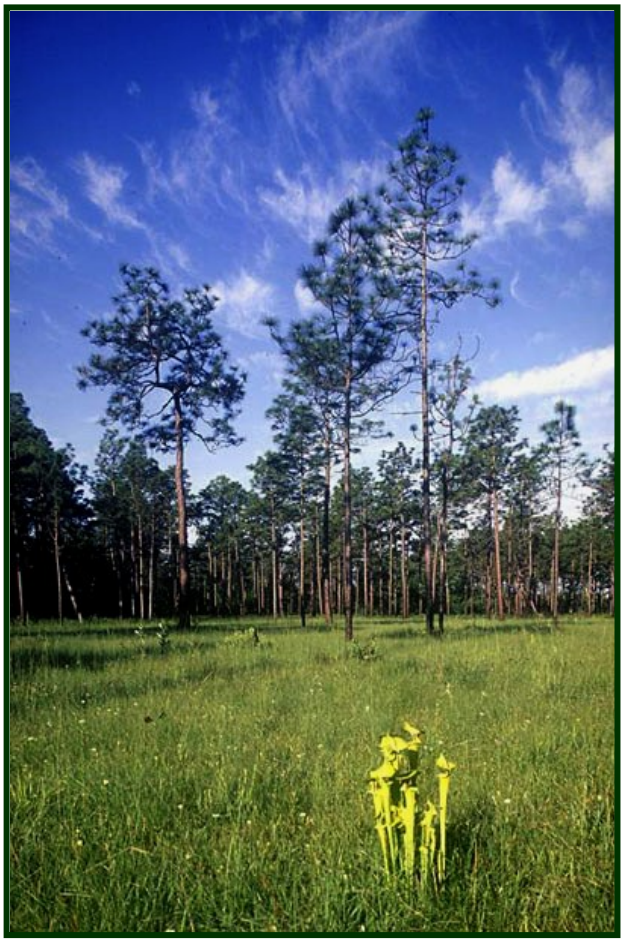
- Establish a vision or goal for your community.
- Identify and describe important species, habitats, and ecosystems in your community. An ecosystem means a group of organisms together in the environment they depend on.
- Develop conservation strategies for protecting species, habitats and ecosystems.
- Write the plan.
- Implement the plan and monitor progress.

Links for Further Research:

- **Town of Lake Waccamaw Land Use Plan (pdf)**
- **Natural Resource Maps of Lake Waccamaw (pdf)**

Activity Ideas:

- **Using the following aerial photo, draw buffers around areas you think need them.**
- **Class creates its own Land Use Plan for the Town of Lake Waccamaw using the linked maps as reference.**



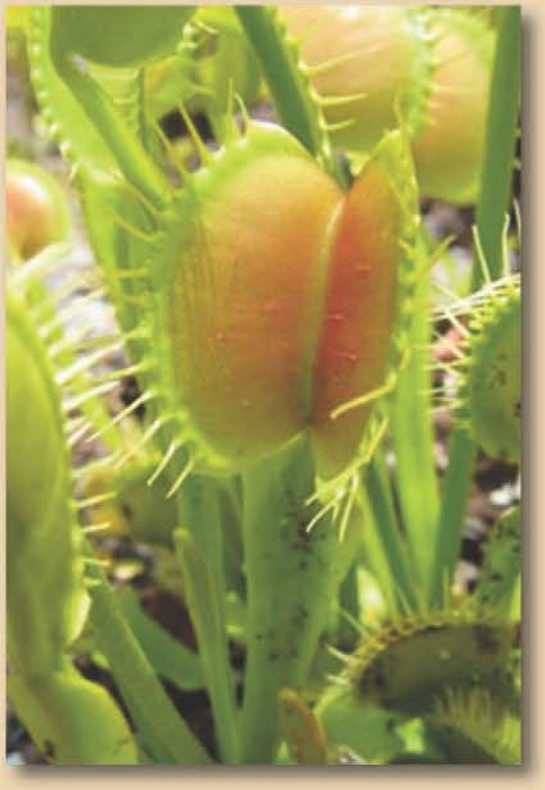
Longleaf Pine Forest by The Nature Conservancy

Burning Pitcher Plants by The Nature Conservancy

THE WACCAMAW WATERSHED

Notes and Thoughts

CHAPTER 3: Our Natural Environment



"The earth has received the embrace of the sun and we shall see the results of that love."

— SITTING BULL

a. Longleaf Pine Forests

Curriculum Ties: High School Biology Objective 5.03

The dry sandy hills in the Waccamaw watershed were once cloaked with magnificent longleaf pines. These tall, strong, majestic trees were replaced with faster growing species like Loblolly Pine. In the Waccamaw region, longleaf pine forests are different depending on if they grow in a dry or wet area. All of the longleaf forests need fire in intervals between 1-10 years depending on the type. Many land managers use fire every 3-5 years depending on forest conditions.[12] A lot of plants that grow alongside longleaf pine trees depend on fire to make or spread seeds and to out-compete other plants. Many animals have stronger populations in fire-maintained longleaf pine forests because of increased food like tender plants, seeds, and fruit. Some human benefits from fire include:

1. Reduces forest debris which reduces wildfires that result in loss of trees, and homes.
2. Reduces plant competition around trees to increase tree growth.
3. Releases nutrients, mainly phosphorus, back into the soil.
4. Reduces populations of ticks, chiggers, and other insect pests.
5. Increases visibility and access into the forest.

Links for Further Research:

- **Brunswick County Natural Area Inventory (pdf)**
- **Columbus County Natural Area Inventory (pdf)**
- **The Longleaf Alliance (www.longleafalliance.org)**

Activity Ideas:

- **Visit the Cape Fear Museum's exhibit "Land of the Longleaf Pine".**
- **Research "prescribed fire" and discover how it is used by land managers.**

Longleaf Pine Savanna by Dale Suiter

ENVIRONMENT

b. Pocosins & Carolina Bays

Curriculum Ties: High School Environmental Science Objective 4.05

Pocosins are unique shrub wetlands of the Southeastern Coastal Plain, many of which have undergone human conversion to agriculture or pine plantations. Conversion means a change in the form of something. Lack of natural fire has affected the number of pocosin types. Pocosins are often found intermingled within longleaf pine forests. In the small area between pocosin and longleaf forests, fire creates habitat needed by rare and endangered plants like rough-leaved loosestrife (*Lysimachia asperulifolia*) and American chaffseed (*Schwalbea americana*). Endangered means the species is threatened to become extinct. Extinct is when a species no longer lives on earth. Pocosins also provide important wildlife food and cover that cannot be found within the longleaf pine forest. A well connected system of these habitats in the landscape is good for the plants and animals of this region.

Many of the natural lakes in southeastern North Carolina are Carolina Bays. Carolina bays can vary in size and the amount of open water; from a half acre bay with shrubs to a 9,000 acre open water lake like Lake Waccamaw. These lakes are pretty common in our area and provide habitat for aquatic and semi-aquatic animals. Fish, mussels, clams, and crayfish are aquatic animals that stay in the water. Reptiles, amphibians, beavers and otters are semi-aquatic animals that thrive in natural lakes and the surrounding wetlands. Alligators are found in natural lakes or surrounding canals, where food is plentiful. Numerous bird species also use natural lakes for nesting, resting, and feeding sites. Common yellowthroat and red-winged blackbirds are common nesters along shorelines. Osprey dive for fish in the lakes, and use surrounding tree snags for nesting.

Links for Further Research:

- **Carolina Bay Fact Sheet (pdf)**
- **Osprey Fact Sheet (pdf)**

Activity Ideas:

- **Visit Google Earth and discover which NC county has the highest number of Carolina Bays.**
- **Host a classroom debate about the different theories of origin of Carolina Bays.**

Lake Waccamaw

ENVIRONMENT

c. Floodplain Forests= Filters for our Waterways

Curriculum Ties: High School Environmental Science Objective 4.01

Floodplain Forests are found along rivers and streams in the flood zone. Cypress-Gum Swamps and Hardwood swamps are the most common floodplain forests in the Waccamaw watershed. Millions of acres of floodplain forests were present before European settlement, and now just small pieces remain. The floodplain forests were used for agriculture, logging or development. Threatened species like the bald eagle, Rafinesque's big-eared bat, and Eastern woodrat use these riverside forests. They also serve as travel corridors for wide-ranging wildlife like bear. Corridors are narrow passages between larger areas of land.

Cypress-gym swamps contain only a few tree species that can withstand many months of flooding. These trees are bald cypress, pond cypress and black gum. Hollow cypress and swamp black gum trees are important for cavity dwelling species like bats and birds. Dead trees in these swamps also serve as nesting posts for colonial waterbirds like great blue herons, egrets, anhingas, and woodstorks.

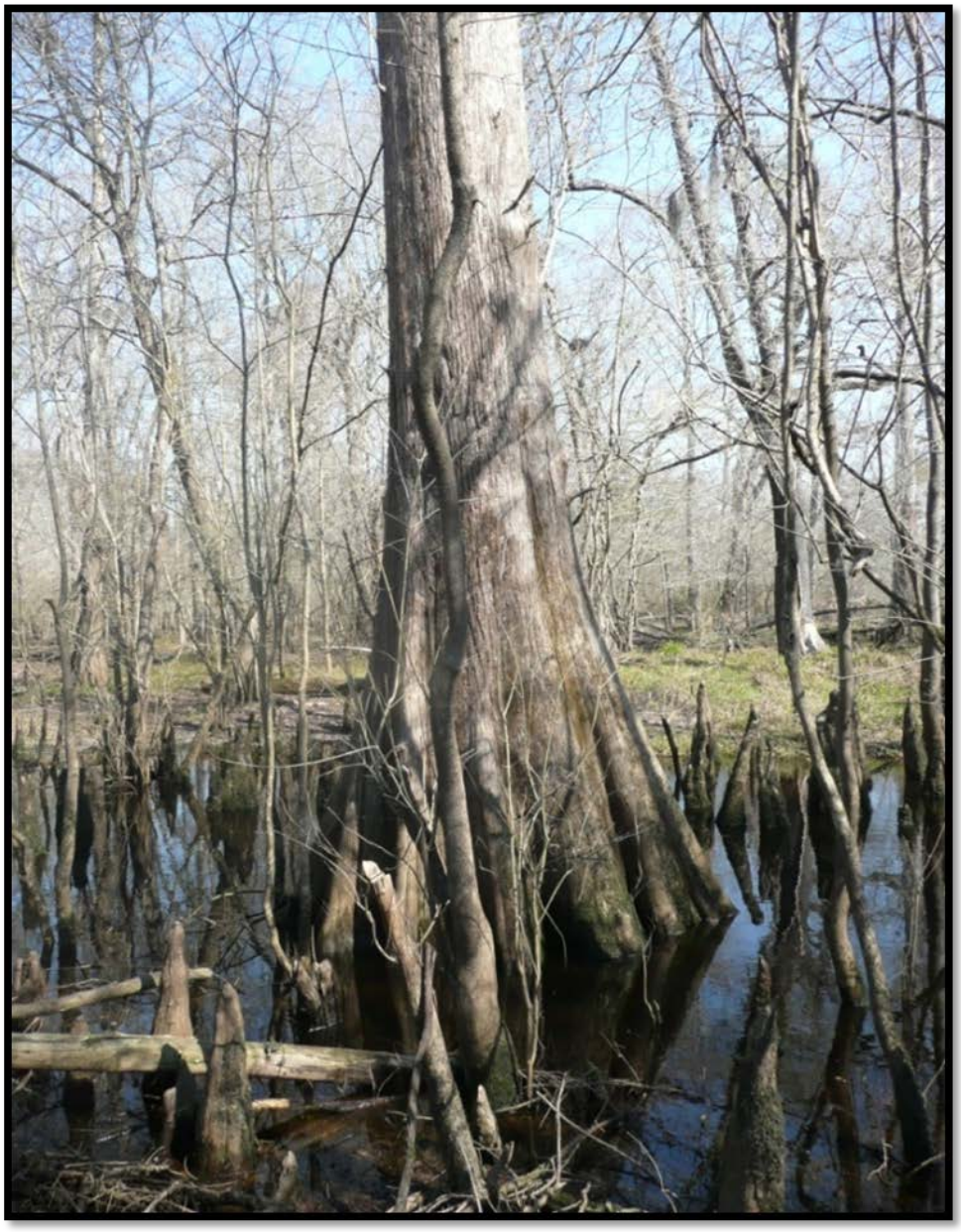
Hardwood forests are located on higher portions of the floodplain and have oaks, red maple, sweetgum, and loblolly pine.

Links for Further Research:

- **NC Zoo Online Description of Cypress Swamp (http://www.nczoo.org/animals/NorthAmerica/cypressswamp.html)**
- **Watch harvesting of floodplain forests on "Swamp Loggers" (www.wway.tv3.com/swamploggers)**

Activity Ideas:

- **Find out where the oldest Cypress Trees grow in the East.**
- **List all of the uses of trees that you can think of. Then look up uses of wood or trees. Add to your list 3 items you should have known, and 3 items you never would have guessed.**



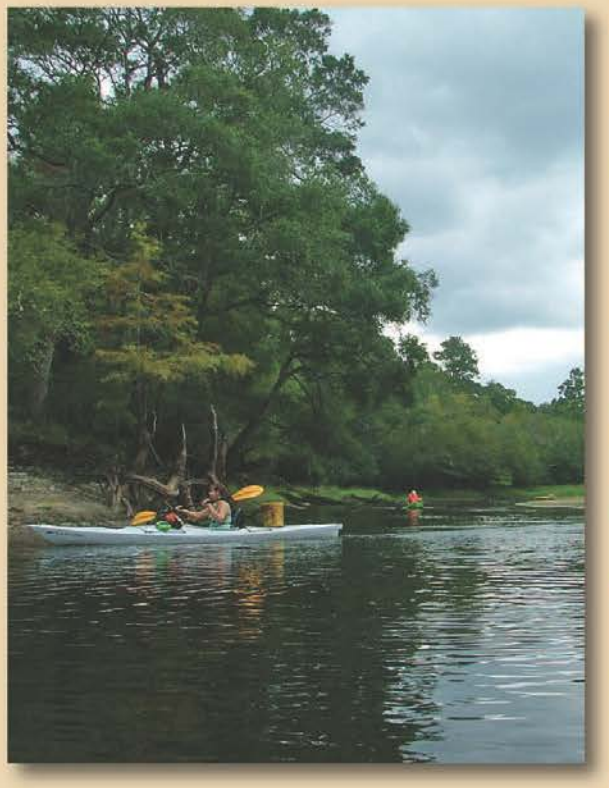
Cypress-Gum Swamp by the NC Coastal Land Trust

OUR NATURAL ENVIRONMENT

Notes and Thoughts

Loosestrife by Dale Suiter

CHAPTER 4: Money, Money, Economy $



"We are not afraid to work, and we are not afraid to do right."

— TOOKLANNI

a. Forestry is Fundamental

Curriculum Ties: 8th Grade Social Studies Objective 7.01

Forestry has a long and influential history in the Waccamaw River region. Influential means having a strong effect on something. The map below shows current lands in forestry production. Much of the area has been in timber land for more than 100 years. Particularly prized were the Cypress and Longleaf Trees. Cypress was a highly prized wood and virtually all forests containing Cypress show old stumps. Cypress grows slowly and only under particular flooding conditions, so only a few large Cypress trees remain. Longleaf pine was heavily used throughout the southeastern United States for naval supplies and timber. Live oak was popular for furniture use. Other hardwoods are also valuable timber species. Pulpwood is a major timber by-product from southeastern North Carolina. Pulpwood is wood used to make paper.

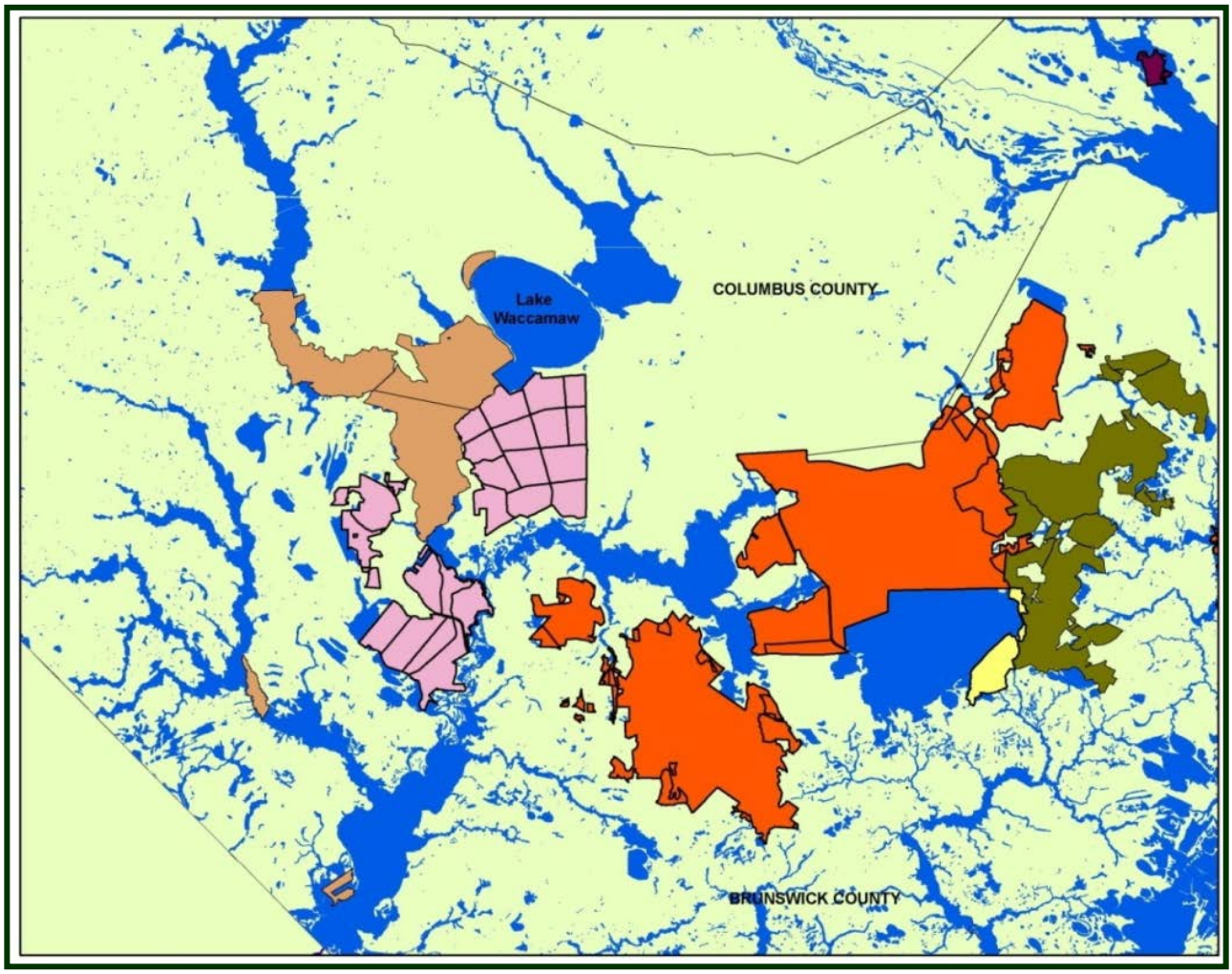
Links for Further Research:

- **North Carolina Forestry Association (http://www.ncforestry.org/)**
- **Longleaf Leaflet by NC Forest Service (pdf)**

Activity Ideas:

- **Visit a local timber company or the Reigelwood Plant to learn more about forestry.**
- **Write a one-page report on a commercial tree of interest.**

Loblolly by NC Coastal Land Trust



Map of Timber lands by NC Coastal Land Trust

ECONOMY

b. Authentic Agriculture

Curriculum Ties: 8th Grade Social Studies Objective 1.01

Agriculture is a large rural economy for several communities in NC. Overall, it represents only a small proportion of land use in the state. Small farms of soybean, corn, hay and tobacco are present in the Waccamaw watershed. Industrial agriculture, such as hog farming, occurs along tributaries of the Waccamaw River and in the headwaters area. Columbus County has 777 farms, and holds an Agricultural Fair each year. Its top commodities are swine, chicken and tobacco. Towns within Columbus County hold additional fairs celebrating watermelons, strawberries, and yams.[13] In Brunswick County, there are 264 farms with top commodities of swine, vegetables and plants.[14]

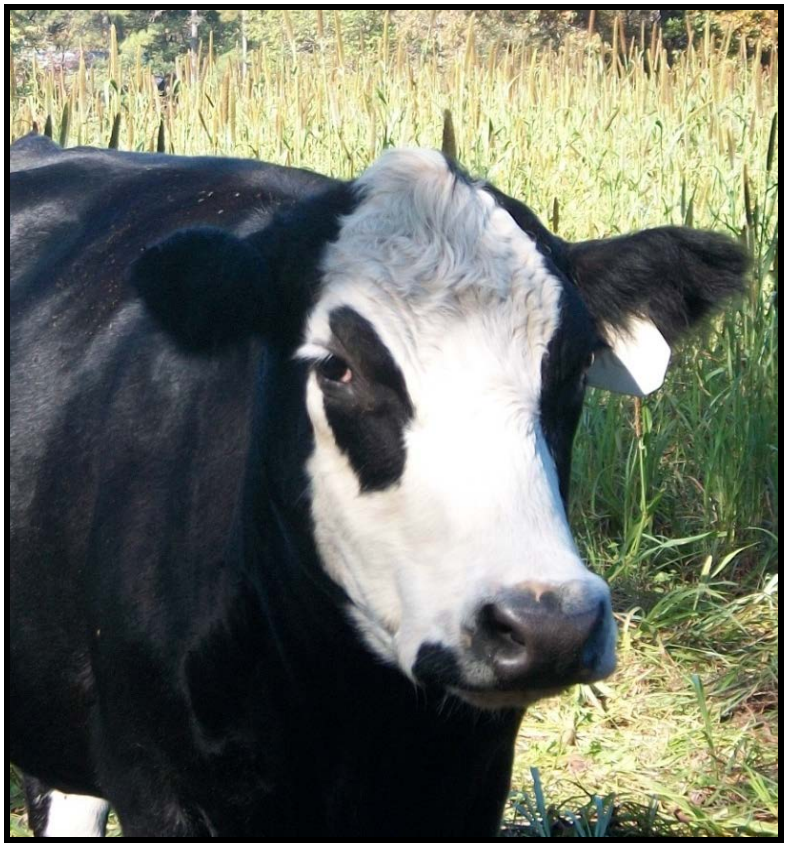


Photo by NC Coastal Land Trust

Links for Further Research:

- **NC Department of Agriculture (www.ncagr.gov)**
- **NC Cooperative Extension-Columbus County (http://columbus.ces.ncsu.edu/)**
- **NC Cooperative Extension-Brunswick County (http:// brunswick.ces.ncsu.edu/)**

Activity Ideas:

- **Visit a local farm or farmers market and inventory all of the items for sale.**
- **Interview a local farmer about their farm and their family history in NC.**

Juniper Creek by The Nature Conservancy

ECONOMY

c. Eco-Tourism

Curriculum Ties: 8th Grade Social Studies Objective 1.01

Recreation is a very important attraction to Columbus County. The area is scenic and rural, however, not many tourist amenities exist. Hotels are scarce, as well as public access to the river and lake. Lake Waccamaw State Park provides camping, along with environmental education programming for kids and weekend visitors.

Brunswick County has more tourist amenities, but they are concentrated towards the beaches. Portions of the county in the Waccamaw watershed are not currently set up as tourist attractions.

The cool, tea-colored waters of Lake Waccamaw make it one of the most unique bodies of water in the world. At Lake Waccamaw, you can view one of the greatest geological mysteries of the eastern United States—the phenomenon of Carolina bays. Limestone bluffs along the north shore neutralize Lake Waccamaw's water, making the lake different from any other Carolina Bay. Nearby, you can catch a glimpse of a botanical wonder—the Green Swamp. From its sandy shorelines to its tree-lined natural areas, Lake Waccamaw offers peaceful surroundings.

State government interest in the bay lakes emerged in the early 1800s when legislation blocked further private claims on land covered by lake waters. Later, the General Assembly declared that any lake of 500 acres or more in Bladen, Columbus or Cumberland counties shall remain the property of the state. [15]

In October of 1964, the Board of Conservation and Development tried to obtain land on the lakeshore to establish a state park. But it wasn't until May of 1976 that a state park was formed on the lake when a 273-acre tract of land was purchased by the NC Division of Parks and Recreation. Additional land purchases for the park in the mid-1980s, including land once belonging to the Federal Paper Company and Georgia-Pacific Corporation, helped bring the Lake Waccamaw State Park to its present size of 1,732 acres. [16]

Communities in Columbus and Brunswick Counties recognize the Waccamaw River as an important resource to their region of North Carolina. The river contributes to the area's quality of life and serves as a local economic asset offering opportunities for recreation, tourism, and education.

The Waccamaw River forms the boundary between Columbus and Brunswick Counties in North Carolina, providing an opportunity for collaboration between the two counties. Once the river flows into South Carolina, it serves as the drinking water source for Horry County, making regional coordination important too.

Organizations in South Carolina have done tremendous work in conserving their portion of the river through education, water quality monitoring, a paddle trail, a National Wildlife Refuge, and private lands conservation. The development of a paddle trail is already underway and has received local support. The Blue Trail was also recognized as one of President Obama's "America's Great Outdoor" Projects in 2011. [17]

Links for Further Research:

- **"America's Great Outdoors" Press Release (pdf)**
- **Parks' Impact: $400 Million (pdf)**

Activity Ideas:

- **Write about a nature adventure you've had recently or in the past.**
- **Visit Lake Waccamaw State Park**

ECONOMY

d. Local Business= "Bread & Butter"

Curriculum Ties: High School Biology Objective 5.03; 8th grade Social Studies Objective 1.01

Columbus County's Largest Employers

Company	Industry Description	Employment
Columbus County Board of Education	Education	1000+
International Paper	Manufacturing	500-999
State of NC Department of Correction	Public Administration	500-999
Columbus County	Public Administration	500-999
Columbus Regional Healthcare System	Health Services	500-999
BB&T	Financial Activites	250-499
Whiteville City Schools	Education	250-499
Southeastern Community College	Education	250-499
Wal-Mart	Retail	250-499
Select Services Inc.	Professional Services	250-499

Brunswick County's Largest Employers

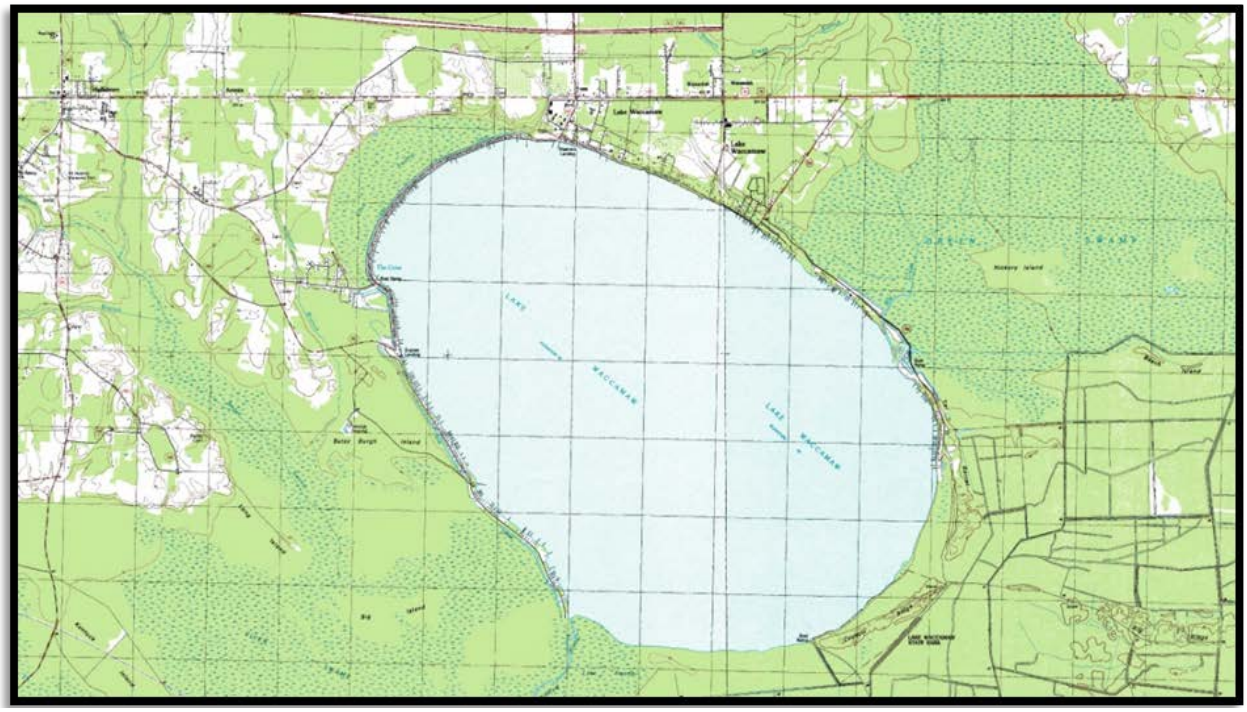
Brunswick County Board of Ed.	Education & Health Services	1000+
County Of Brunswick	Public Administration	1000+
Wal-Mart Asso. Inc.	Trade, Transportation & Utilities	500 - 999
Progress Energy Carolinas	Trade, Transportation & Utilities	500 - 999
Brunswick Community College	Education & Health Services	250 - 499
Brunswick Community Hospital LLC	Education & Health Services	250 - 499
Food Lion	Trade Transportation & Utilities	250 - 499
DAK Americas	Trade, Transportation & Utilities	250 - 499
J. Arthur Dosher Hospital	Education & Health Services	250 - 499
Marine Terminals Corp. East	Trade Transportation & Utilities	250 - 499
Bald Head Island	Financial Activities	250 - 499
Department of Defense	Public Administration	250 - 499
Lowes Home Centers	Trade Transportation & Utilities	100 - 249
Lowes Food Stores Inc	Trade, Transportation & Utilities	100 - 249
Troon Golf LLC	Leisure & Hospitality	100 - 249
Securitas Security Services USA Inc	Professional & Business Services	100 - 249
Victaulic Co Leland Facility	Manufacturing	100 - 249
B & K Coastal LLC	Construction	100 - 249
Atlantic Telephone Membership	Information	100 - 249
SBH Wilmington LLC	Education & Health Services	100 - 249
Brunswick Cove Living Center LLC	Education & Health Services	100 - 249
Harris Teeter Inc	Trade Transportation & Utilities	100 - 249
Town of Oak Island	Public Administration	100 - 249
Archer Daniels Midland Co	Manufacturing	100 - 249
Ocean Ridge Plantation Golf Inc	Leisure & Hospitality	100 - 249

Links for Further Research:

- **Columbus County Economic Development Commission (www.columbusedc.com)**
- **Brunswick County Economic Development Commission (www.brunswickedc.com)**

Activity Ideas:

- **Visit a local business and find out why they are located in Brunswick or Columbus county.**
- **Choose a business from the list and research their operation, employees, and location.**



Lake Waccamaw Topographic Map

Longleaf Pine Needles by Wikipedia

MONEY, MONEY, ECONOMY

Notes & Thoughts

CHAPTER 5: Water of Waccamaw

"We are a part of the earth, and the earth is part of us."

— SEATTLE

a. The Good ☺ and the Bad ☹

Curriculum Ties: High School Environmental Science Objective 4.04; 8th Grade Science Objective 1.05

Maintaining good water quality, especially in waterfront areas is important because tourism, recreation, industries and fisheries all depend on it. The quality of water depends on how humans use the land surrounding streams and rivers. Two main sources of pollution exist: point pollution and nonpoint pollution. Point source pollution describes pollutants that come from a specific point or source, such as a factory discharge pipe or a sewage plant. Discharge means to release something. Nonpoint source pollution cannot be traced to a single source, but is made up of many sources. Stormwater runoff from rainwater carries many different pollutants from many different sources on the land, so it is considered nonpoint pollution. Polluted stormwater runoff can carry fertilizers, lawn chemicals, herbicides, road salts, oil and gas, sewage and pet waste. Fertilizers are chemicals that are used to help plants grow. Herbicides are chemicals It can even carry air pollutants like the chemicals sulfur dioxide, nitrogen sulfide and copper that are picked up in the atmosphere as the rain falls.

Polluted runoff can cause serious environmental problems like closed beaches, fishery and shellfish harvest closings, and algae blooms. Large pollution accidents like oil spills get lots of attention. But it is estimated that annual urban stormwater runoff from a large city can contain as much oil and grease as a large tanker spill.

Best Management Practices for Controlling Nonpoint Source Pollution

Roads and Streets

- Dispose of paints, solvents, oil and grease at landfills not in storm drains. A landfill is a place where trash is layered with natural soil to help decomposition.
- Use non-chemical deicers like sand and ash on roads, walkways and driveways in the winter.
- Collect stormwater runoff before it reaches streams.

Construction

- Require plans for new construction.
- Use plants to reduce erosion.
- Use landscaping to collect stormwater.

Residential

- Read labels prior to using pesticides and fertilizers.
- Clean up pet waste.
- Use non-chemical fertilizers on gardens.
- Maintain buffer strips of plants along streams, rivers and lakes.
- Maintain septic tanks to prevent leaks.
- Keep grass clippings and other yard waste out of the waterways.

Recreation

- Pack all trash and litter with you when you leave.
- Don't leave fishing bait, line, hooks in the water or on the shoreline.

Links for Further Research:

- **Town of Lake Waccamaw Land Use Plan (pdf)**
- **Columbus County Land Use Plan (pdf)**
- **Brunswick County Land Use Plan (pdf)**

Activity Ideas:

- **Look at how the County and Town Land Use Plans help protect water quality.**
- **Identify changes needed in your own neighborhood that would help stop pollution.**

Water by Dale Suiter

WATER QUALITY

B. What's in the Water??

Curriculum Ties: High School Environmental Science Objective 4.05; 8th Grade Science Objective

Water quality monitoring means using different measurements to see if there is pollution in the water. Monitoring is also used to better understand the natural water system or relationships between animals and the water.

When deciding how to monitor water quality, there are steps to follow: 1. Define the purpose or goal of the study; 2. Decide what environmental tests will be used; 3. Define how you will take a water sample; 4. Map out where and when to take water samples; 5. Choose who will collect and measure water quality samples; 6. Select who will analyze and report the water monitoring data. The State of North Carolina Division of Water Quality monitors the Waccamaw watershed every year. According of the 2010 Lumber River Basinwide Water Quality Plan, water quality was monitored at four different locations in the Waccamaw watershed and only exceeded state standards for iron. The iron content is considered to be natural. Basin is another word for watershed.

Subwatersheds within the larger Waccamaw watershed include: Red Hill Swamp, White Marsh, Waccamaw River Headwaters, Juniper Creek, Seven Creeks, Gore Branch, and Buck Creek. Each will be discussed below.[18] Subwatersheds are smaller areas within a larger watershed.

Red Hill Swamp

This watershed contains 38 animal operations, making it the largest number in all watersheds within the larger Lumber River watershed. Animal operations are companies that raise animals for commercial purposes (meat eggs, etc). The Red Hill Swamp watershed is rural with only one city, the Town of Clarkton. The Town of Clarkton's Wastewater Treatment Plant is the only point pollution discharge allowed in the Red Hill Swamp subwatershed.

White Marsh

This watershed contains all of the Towns of Chadbourn, Whiteville, and Brunswick. It is the most populated subwatershed in the larger Waccamaw watershed. There are 5 allowed pollution discharges from wastewater treatment plants. A large part of this watershed contains floodplain forests of cypress-gum swamp, known as White Marsh Swamp and Bogue Swamp. During the recent droughts of 2007 and 2008, many acres

in these swamps were clearcut. Clearcut is a forestry practice where all trees in an area are cut for harvest. It is unsure if this will have an impact on water quality.

Waccamaw River Headwaters

All of the swamps and rivers in the Waccamaw River Headwaters subwatershed are classified as Outstanding, and have strict regulations on pollution. Lake Waccamaw and its streams are classified as Outstanding because of their high water quality value, high recreational value, and habitat for different plants and animals. Three fish species and four mussel species are only found in this watershed and nowhere else on earth. The Lake Waccamaw State Park and Columbus County Gamelands are located in the Waccamaw River Headwaters area. Cove Swamp, a 440 acre crescent shaped wetland on the northeast side of Lake Waccamaw was just purchased in 2008 and added to the state park.

Juniper Creek

Over 25% of the Juniper Creek watershed is owned by a conservation organization. The Nature Conservancy owns over 10 square miles and the NC Wildlife Resources Commission owns another 31 square miles. The Myrtle Head Savanna, owned by The Nature Conservancy, is classified as a Unique Wetland by the state due to the presence of Cooley's meadowrue, a federally-listed endangered plant.

Seven Creeks

There are 10 animal operations in the Seven Creeks subwatershed. It also contains Tabor City and its wastewater treatment plant. Lake Tabor, a man-made lake was built in 1952 but its dam breached during the 1996 Hurricane Fran. The dam was re-built in 2000, but when the water was sampled in 2006 it indicated unhealthy conditions. The lake is surrounded by residential development with little buffers. The lake has been taken over by aquatic weeds, which are now being controlled by chemical and mechanical treatments and Grass Carp fish.

Gore Creek

The Gore Creek subwatershed has a rural landscape with only 2 minor wastewater discharges allowed. There are also only 2 animal operations in the watershed. Four separate properties of Columbus County Gamelands help buffer the Waccamaw River. Old Dock Savanna, owned by The Nature Conservancy, is classified as a Unique Wetland, and includes a lot of carnivorous plants. Carnivorous means they eat meat.The NC Coastal Land Trust helped a landowner conserve 296 acres along 4 miles of the Waccamaw River in this subwatershed.

Buck Creek

This subwatershed contains Carolina Shores and Calabash communities. It has one allowed wastewater treatment plant, and one animal operation. This subwatershed extends into South Carolina.

Links for Further Research:

- **2010 Lumber River Basinwide Water Quality Management Plan- Chapter 4 Waccamaw (pdf)**
- **Waccamaw Watershed Academy (www.coastal.edu/wwa/)**

Activity Ideas:

- **Identify the subwatershed you live in. Describe your watershed in your own words.**
- **What else would you like to know about your watershed. How would you find out?**

Floodplain Forest by the NC Coastal Land Trust

Sundew by Dale Suiter

WATER QUALITY

c. Biological, Chemical & Physical- Watch Out!

Curriculum Ties: 8th Grade Science Objective 2.03

Biological

Biological assessments are a way to determine the quality of a habitat. Assessments are studies to evaluate a certain condition, like measuring chemicals. Surveys for aquatic insects are commonly done in rivers and lakes. Surveys for fish are also used as a way to measure the health of a waterway. Living things do not survive in water that is contaminated or unhealthy. Contaminated means that something is unpure because of an outside influence.Flying insects often lay their eggs in water and their eggs become larvae. Larvae are the immature, wingless forms of insects. These insect larvae are studied in a biological assessment. Stoneflies, mayflies, caddisflies, and dragonflies are all flying insects that lay their eggs in water. Healthy oxygen levels, aquatic plants, and clean water are needed for the larvae to survive and eventually become flying insects. Fish and other larger animals rely on these insect larvae as food. Birds and bats rely on the flying adult insects for food. The connection between the health of the water and the health of these animals is clear. Studies that show a large number of different insects will usually mean you have a healthy water system. The larvae of flying insects don't survive well in polluted water. Other macroinvertebrates like leeches and worms, are tolerant of pollution so they will be in water that is contaminated.

Chemical

Humans and aquatic animals need water with pH levels near neutral, so pH is the most common and easily performed water quality test. It measures the acid level in the water. The pH scale ranges from 0 (acidic) to 14 (non-acidic) with a neutral reading of 7. Natural waters usually have a pH between 5 and 9, where most aquatic organisms can survive. If the pH goes higher or lower than this range, most fish and insects will die.

Nitrates are needed for plant growth, but too much can indicate a pollution problem. Sources of nitrates include soil, animal waste, decomposing plants, sewage, fertilizers and animal waste. High levels of nitrates lead to fast plant growth, affecting the types of plants and animals that live in the water. Blood poisoning and cancer in humans have been linked to high levels of nitrates.

Phosporus is needed by plants and animals, in small amounts. Phosphorus is held in rocks or soil and in natural environments it remains at a constant level. Land disturbance like building, logging, and agriculture can lead to soil erosion, releasing phosphorus from upland soils that end up in the water.

Physical

Sediment (small soil particles) in a river or lake makes the water appear cloudy or dirty. A turbidity test measures levels of sediment. Sediment carries sand, clay, waste, lead, bacteria and even viruses. Some suspended matter is natural, and some is produced by human activities. Fish need clear water to see their prey. Insects, eggs, mussels, and snails can be smothered by too much sediment. For humans, sediment is one of the first things filtered out of drinking water because it can hold harmful bacteria. The most common source of sediment is erosion of land by road building, construction, and other activities that disturb soil and plants. Sediment is usually carried by rainwater during storms into nearby streams and lakes.

Temperature measures the degree of heat in the water which affects the rate of many natural processes. Air temperature, cloudiness in the water, and amount of sunlight all affect the water temperature. Temperature affects the rate of photosynthesis and decomposition in plants. Photosynthesis is the process by which plants use the sun to make energy. Decomposition means the break-down of organic materials.

Dissolved oxygen measures the amount of oxygen in water. The oxygen keeps organisms living and supports many chemical processes that happen in the water. Water that has high dissolved oxygen levels is healthy. Low oxygen levels stress fish and other aquatic animals. Interestingly, saltwater, warm water, and water at high elevations contains less dissolved oxygen naturally, and are still part of a healthy ecosystem.

Links for Further Research:

- **EPA World Water Monitoring Day (www.worldwatermonitoringday.org)**
- **Southeastern Community College Presents " The Waccamaw Water Quality Project" (video)**

Activity Ideas:

- **Collect water samples and send them to a local lab for assessment. Discuss results.**
- **Choose what you think is the most important water test. Explain why.**

Pitcher Plants by Dale Suiter

WACCAMAW WATER QUALITY

Notes & Thoughts

CHAPTER 6: Wildlife of Waccamaw

"I love the land on which I was born, the trees which cover it, and the grass growing on it. It feeds us well."

— COMO

a. American Alligator (*Alligator mississippiensis)*

This largest of reptiles is located mostly in the canals and shallow swamps near Lake Waccamaw and the Waccamaw River. As predators at the top of the food chain, they control numbers of rodents and other small mammals that might over eat the wetland plants. Alligators mostly eat fish, turtles and snails. American Alligators can remain underwater for several hours if they are not swimming or hunting. If they are swimming or hunting, they can stay underwater for about 20 minutes.

Adult male alligators average 11.2 ft in length, while adult females average 8.2 to 9.8 feet. Average adult Alligators weigh from 270 to 800 lb. [19] The tail, which accounts for half of the alligator's total length, is used for swimming. The tail can also be used as a weapon of defense when an alligator feels threatened. Alligators travel very quickly in water and they can lunge short distances very quickly on land. American Alligators have the strongest bite of any living animal.

Links for Further Research:

- **Threats to the American Alligator (www.defenders.org/american-alligator/threats)**
- **Alligators vs Crocodiles (http://animals.howstuffworks.com/reptiles/alligator-vs-crocodile.htm)**

Activity Ideas:

- **Draw a picture of an alligator and scale it to represent 10 feet long.**
- **Visit the NC Aquarium at Fort Fisher to see alligators up close.**

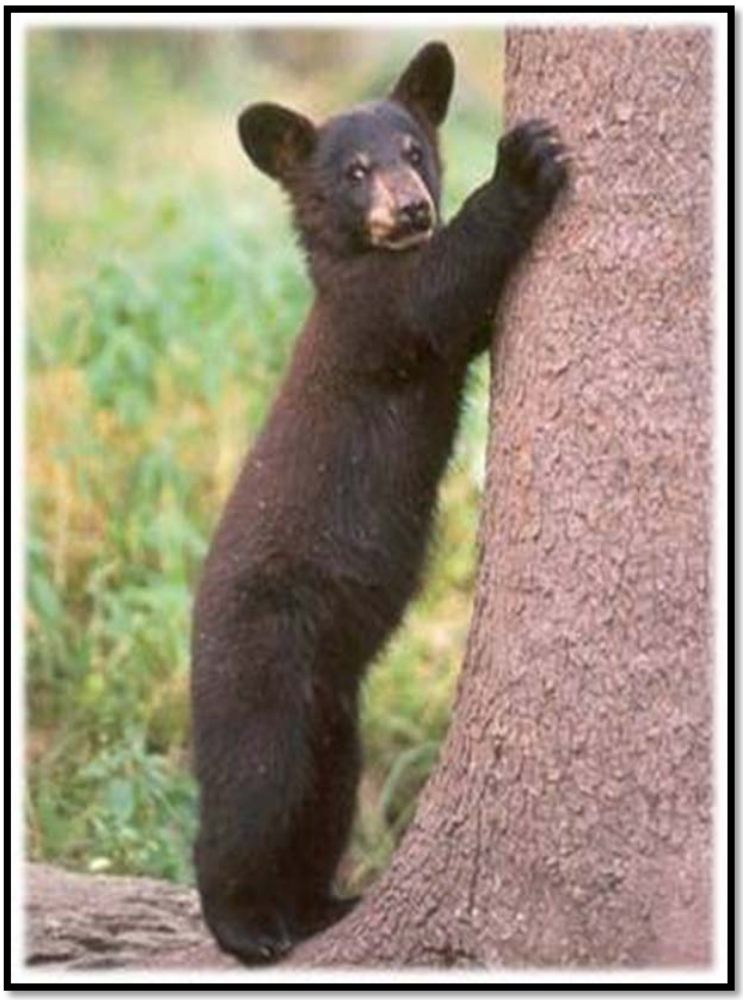
American Alligator by Amy Bernhardt

WILDLIFE

b. American Black Bear (*Ursus americanus)*

Black bears are known to thrive in the Waccamaw River watershed. The bears use the river floodplains as travel corridors Black bears use up to 2000 to 5000 acres or more of habitat, and use forested wetlands for movement. [20] Black bears can use many different habitat types, but they require thick underbrush for building dens, and large trees like oak for food. Black bears are omnivores, with their diets varying greatly depending on season and location. They typically live in largely forests, but they do leave forests in search of food.

American black bears often mark trees using their teeth and claws as a form of communication with other bears, a behavior common to many species of bears.



Black Bear Cub by Deanna Ruth

Links for Further Research:

- **NC Black Bear Management Plan (pdf)**
- **North American Bear Center- watch live bears (www.bear.org)**

Activity ideas:

- **Investigate all of the different ways that biologists study bears and why.**
- **Compare the two species of bears found in the United States**

WILDLIFE

c. Eastern Fox Squirrel (*Sciurus niger*)

Eastern Fox squirrels are the largest tree squirrel native to North America. The fox squirrels live in the eastern United States, excluding New England, and west to Colorado and Texas. [21] Eastern fox squirrels are most common in open forests with few large plants on the ground. Ideal habitat is small stands of large trees mixed with agricultural land. The size and spacing of pines and oaks are among the most important features of eastern fox squirrel habitat. Eastern fox squirrels may make their own den in a hollow tree by cutting through to the tree interior. They also use natural cavities or cavities created by birds like northern flickers (*Colaptes auratus*) or red-headed woodpeckers (*Melanerpes erythrocephalus*).

Links for Further Research:

- **Northern flicker (http://www.allaboutbirds.org/guide/Northern_Flicker/id)**
- **Red headed woodpecker (http://www.allaboutbirds.org/guide/Red-headed_Woodpecker/id)**

Activity Ideas:

- **Visit a nearby longleaf forest or oak forest and see if you can find an Eastern Fox Squirrel.**
- **Make a mask of one of the many different fox squirrel colors you can find on the internet.**

Eastern Fox Squirrel by Wikipedia

WILDLIFE

d. Wood Stork (*Mycteria americana*)

The Wood Stork is a federally-endangered species. It is found mostly in South America, Central America and the Caribbean. It is the only stork that breeds in North America. There is a small and endangered population in Florida, Georgia, and South Carolina, along with a recently discovered colony in southeastern North Carolina. Just along the border in North Carolina, is the most northern nesting colony of Woodstorks in the country. Woodstorks may travel up to 80 kilometers away from their nesting sites to feed. Nesting sites are very particular, in that they need to have open water below nesting trees to prevent predators from reaching the nests. The Wood Stork builds a large stick nest in a forest tree. They nest with up to twenty-five nests in one tree. Breeding once a year, a female lays 3-5 eggs and the eggs are incubated 27–32 days by both parents. [22]

Woodstork Colony by David Allen

Links for Further Research:

- **Wood Storks by National Geographic (http://animals.nationalgeographic.com/animals/birds/wood-stork/)**
- **Colonial Nesting Waterbirds (pdf)**

Activity Ideas:

- **Locate potential woodstork colony habitats along the Waccamaw River using a topographic map and using the criteria given above.**
- **Draw a feeding area around a woodstork colony using the information above.**

WILDLIFE

d. Red Cockaded Woodpecker (*Picoides borealis*)

The animal most adapted to longleaf pine forests is the red-cockaded woodpecker (*Picoides borealis*). Adapted means they have developed characteristics because of their living conditions. These federally-endangered birds need mature pine forests. They make cavities in live trees and like to feed in the open meadows below. Recovery of red-cockaded woodpecker populations may be most in need of old trees for nesting and using fire to manage the pine forests.

The Red-cockaded Woodpecker's distinguishing feature is a black cap and large white cheek patches. Rarely visible, except during the breeding season, the male has a small red streak on each side of its black cap called a *cockade*, hence its name.

The Red-cockaded Woodpecker feeds on ants, beetles, cockroaches, caterpillars, wood-boring insects, spiders, and occasionally fruit and berries. [23]

Red-Cockaded Woodpecker by Wikipedia

Links for Further Research:

- **Recovery of the Red-Cockaded Woodpecker (http://www.fws.gov/rcwrecovery/)**
- **Safe Harbor Program for Red-Cockaded Woodpecker (pdf)**

Activity Ideas:

- **Look up bird house dimensions for your favorite bird and make a bird house. Try to hang it in the appropriate habitat for your bird.**
- **Describe how the red-cockaded woodpeckers look different from other NC woodpeckers.**

WILDLIFE

e. Carolina Gopher Frog (*Rana capito capito*)

Carolina gopher frogs are large, interesting, and elusive frogs. They breed in seasonal water pools in sandy longleaf forests. The Carolina gopher frogs have become rare because their breeding pools have been destroyed humans, or colonized by fish and plants. Small, natural, seasonal pools will eventually be taken over by shrubs unless occassional fires keep them open. Carolina gopher frogs will travel up to 2 miles from water to feed and burrow in burned out stumps. They stick their head out of the burrow hole and catch insects as they travel by.

Gopher Frog by Todd Pusser

Links for Further Research:

- **Frogs and Toads of NC (http://www.herpsofnc.org/herps_of_NC/anurans/anurans.html)**
- **NC Conservation of Carolina Gopher Frog (http://ncwrc.conservationregistry.org/projects/15863)**

Activity Ideas:

- **List all of the different frog species in North Carolina. Pick your favorite and document its life cycle.**
- **Explain why these frogs are called "Carolina Gopher" frogs**

Looking for Wildlife by Waccamaw Riverkeeper

WILDLIFE OF WACCAMAW

Notes & Thoughts

CHAPTER 7: Our Endemic Species

"What is life? It is the flash of a firefly in the night... it is the little shadow which runs across the grass and loses itself in the sunset."

— CROWFOOT

a. Biodiversity What??

Biodiversity is a word used to describe the variety of life forms or species in an area. A species is endemic to a place if it lives nowhere else but at that place or region.

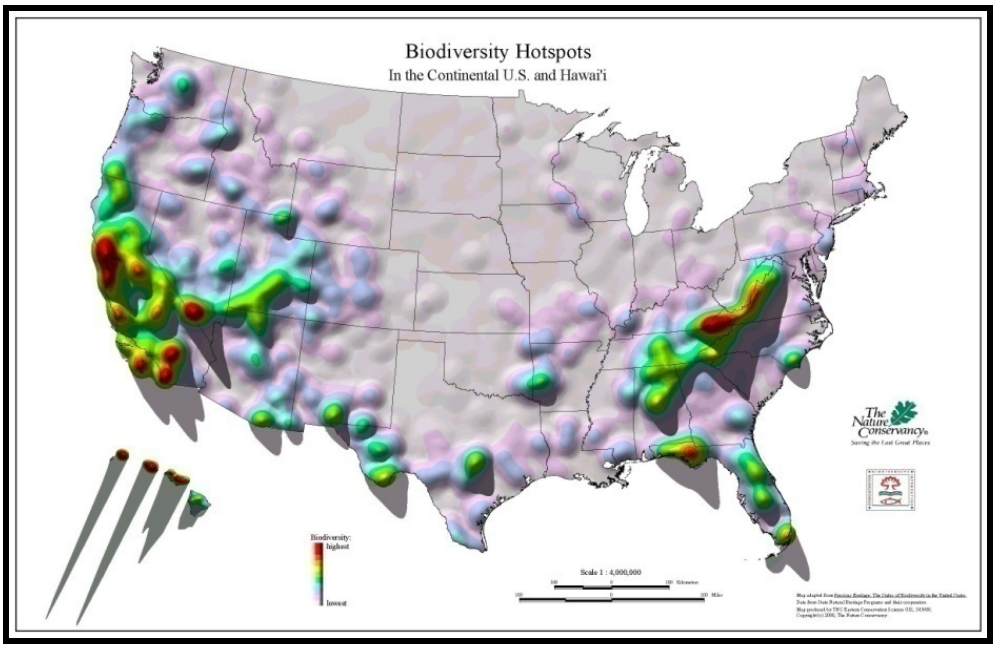
The uplift of sand and limestone deposits called the Cape Fear Arch is home to plants and animals found nowhere else in the world. 22 plants and 19 animals are considered endemic to the Cape Fear Arch region located in southeastern North Carolina. Because of the unique animals and plants, the coastal plain of North and South Carolina is considered the most biologically diverse area on the east coast, aside from Florida. There are 298 different species of plants and animals that share our home in southeastern North Carolina. According to the N.C. Wildlife Action Plan, the coastal plain ranks among the top 10 in the United States for the number of reptile, bird and tree species. [24]

Links for Further Research:

- **NC Wildlife Action Plan- Mid Atlantic Coastal Region (pdf)**
- **List of Endemic Species in the Cape Fear Arch (pdf)**

Activity Ideas:

- **Pick another region in the US that has high biodiversity and present a summary to the class.**
- **List all the wild animals and plants you can in 1 minute.**



Biodiversity Hotspots by The Nature Conservancy

ENDEMIC SPECIES

b. Waccamaw Spike (*Elliptio waccamawensis*)

This mussel is endemic to the Waccamaw drainage system and is found in coarse to fine sand. There are three other endemic mussels found in the Waccamaw watershed.

c. Waccamaw Crayfish (*Procambarus braswelli*)

This crayfish is only known from the Waccamaw River watershed in Columbus County, North Carolina. Its habitat is swift, clear, small to medium sized sand-bottom streams flowing through swampy areas.

d. Waccamaw Darter (*Etheostoma perlongum*)

Photo by Fritz Rhode

The Waccamaw darter is a variety of the Tessellated darter (*Etheostoma olmstedi*) and has evolved into a unique fish in the environment of Lake Waccamaw. The Waccamaw darter is pretty common in the lake and numerous nests were seen during a fish survey in 2000 by the US Fish & Wildlife Service. More than a dozen nests were seen especially along the shore east of the dam. Several large storms have blown woody debris into the lake, which will provide additional spawning habitat for the Waccamaw darter. [25]

e. Waccamaw Killifish (*Fundulus waccamensis*)

Photo by Fritze Rhode

The Waccamaw killifish is widespread in the canals immediately surrounding the lake and in lower Big Creek, especially during the winter. The Waccamaw killifish also occurs just below the dam in the Waccamaw River, however it was not found further than 100 meters below the dam.[26] Presently, the population of the Waccamaw killifish appears stable. An assessment of habitat concluded that there is still plenty of suitable habitat available for spawning and nursery areas for the fish. The Waccamaw killifish requires shallow, sandy shorelines.

f. Waccamaw Silverside (*Menidia extensa*)

The Waccamaw silversides are almost never found outside of Lake Waccamaw with the exception of specimens collected just below the dam. Large schools of Waccamaw silversides can be found near the shoreline, especially when the water is choppy. The Waccamaw silverside is probably the most abundant fish in the lake. They are found in greatest numbers along the north and northeast shores. The Brook silverside (*Labidesthes sicculus*) was just discovered in Lake Waccamaw in 1988. [27] The Brook silverside does not naturally occur in Lake Waccamaw so it must have been placed there by humans. The two species live in different habitats, with the Waccamaw silverside preferring open water, and the Brook silverside preferring sheltered aquatic plants.

Links for Further Research:

- **Cape Fear Arch Activity Guide (pdf)**
- **Cape Fear Arch Conservation Plan (pdf)**

Activity Ideas:

- **Go Fishing! (or netting for minnows). Take pictures of the catch, so the students can take their time identifying the fish.**
- **Look up a fish you like to catch fishing, or eat, or observe in the fish tank. Write an interesting one-page fact sheet on the animal.**

Sedge by Dale Suiter

OUR ENDEMIC SPECIES

Notes & Thoughts

CHAPTER 8: Just For Fun

"Let us look forward to the pleasing landscape of the future."

— CHIEF ROSS

a. Lake Waccamaw Field Day

Environmental Education Learning Experience- Aquatic Organisms

Lake Waccamaw State Park's primary EE theme explores the amazing diversity of animal life found in the lake with a focus on freshwater mollusks and endemic fish. Park staff provides a variety of environmental education and interpretive programs to encourage protection of the lake's water quality and biodiversity. The park's Environmental Education Learning Experience (EELE), "One of a Kind", includes hands-on activities that allow students to study and inventory freshwater mussels.

The exhibit hall in the park visitor center allows visitors to study the lake's fish, snails and mussels without getting wet. Other important educational themes in this highly diverse park include the mysterious origins of Carolina bays, carnivorous plants, fire in natural communities and one of Lake Waccamaw's most popular residents, the American alligator.

Lake Waccamaw's water quality and chemistry contribute to an interesting mix of animal life in the park. Several species are found only in and around the lake and nowhere else on earth. These species, known as endemics, include such fish species as the Waccamaw darter, Waccamaw silverside and Waccamaw killifish. An unusual diversity of mollusks are also present including the endemic Waccamaw spike and Waccamaw fatmucket among the 15 species of mussels found here. There are also 11 snail species with the Waccamaw amnicola and Waccamaw siltsnail being endemic to the lake. Along with a nice selection of carnivorious plants, there are also more than 5 plant species on the state's rare plant list including: Venus-hair fern, green-fly orchid, seven-angled pipewort, narrowleaf yellow pondlily and water arrowhead. [28]

Links for Further Research:

- **Lake Waccamaw is 2011 NC Park of the Year (pdf)**
- **Lake Waccamaw State Park website (http://www.ncparks.gov/Visit/parks/lawa/main.php)**

Activity Ideas:

- **Visit Lake Waccamaw State Park and Participate!**
- **View the Lake Waccamaw State Park Video (video)**

Bay Lake by Richard LeBlond

JUST FOR FUN

b. Outdoor Classrooms

Outdoor Classroom Committee

Partnerships are important to develop when planning for an outdoor classroom. Consultation with all faculty and outside organizations involved in your school will ensure that the outdoor classroom will serve the needs of all subject areas and fit into a variety of curriculum requirements. Forming an Outdoor Classroom Committee is a good idea, and can be used to develop a site plan, funding plan, and maintenance task list. The cost of the outdoor classroom should be considered, but not hinder planning for what the school really wants and needs. [29] Many outdoor classrooms can be built in phases, starting with no cost and then adding features as funding becomes available. Funding sources are numerous, but must be approached with a solid plan for the outdoor classroom. Potential funding sources include: school PTA, local service clubs, conservation organizations, local businesses, Soil & Water Conservation Districts, Farm Bureaus, and school fundraising events like dinners, bake sales and raffles.

Outdoor Classroom Features

Animal Tracking Plots- Clearing a small area and filling with clay or sand, can create an animal tracking plot in your schoolyard. Birds, mice, squirrels, rabbits, deer, raccoons will visit even urban settings. Grain, seed, or native plants can attract wildlife to the area of your tracking plot.

Food Plots- By planting trees, shrubs, vines, and herbs that are the preferred food of certain wildlife, your students can attract wildlife species to your schoolyard. Even if they are unable to observe wildlife directly, because many are nocturnal, they can observe signs of wildlife the next morning by looking at how they forage on the various plants.

Botanical Gardens- Planting a variety of native tree, shrub and herbaceous species can help students learn plant care, identification techniques, observe wildlife use of plants, and create plant crafts.

Wildlife Blind- A simple wood structure covered with chicken wire and camouflaging materials can serve as a blind where students can observe wildlife without being seen.

Bird Feeders- Feeding stations around the school yard will give students the opportunity to identify various species of local birds, and learn their food preferences.

Nesting Boxes- Bluebird boxes have been very successful at increasing the population of this declining species. Nesting box entrance hole diameter is the key feature in attracting different species of birds. Wooded fence rows, grassy meadows and areas near waterbodies are good places for nesting boxes.

Butterfly Garden- By planting bright wildflowers and host species for caterpillars, students can learn about the life cycle of butterflies and moths.

Compost Pile- Leaves, grass clippings, yard debris and kitchen scraps can be added to a compost pile which can then be used as a source of soil and nutrients for school gardens.

Woodlot- Nearby timberstands or natural woods can be used as learning centers if they are properly managed. Talk to the adjacent landowner to gain permission to use nearby woodlands for students. If the school owns the woods, talk to a forester about how the area can be managed to accommodate students and enhance the biological integrity of the woods. If trees need to be cut from the woods, encourage the loggers to create a few clean cut stumps that can be used to study tree cross-sections.

Watering Hole- Creating a small, shallow pool of water will attract amphibians and other wildlife to the schoolyard. Aeration of the water is important to maintain the quality. Natural aquatic plants can be planted to accommodate amphibian and insect eggs.

Outdoor Seating Area- A simple set of wooden benches, old telephone poles, or railroad ties can serve as an outdoor amphitheater where any class can be conducted in the beauty and quiet of the outdoors. Just being outside can increase a student's interest in a subject; and also their ability to focus for long periods of time on reading or writing activities.

Trails- A designated walking trail, even if it's just around the schoolyard, can be a great asset for the school. Students can stop at different areas to observe sights, sounds, smells, and record information in a nature notebook. Trails can be surfaced with woodchips or stone, and access over wet areas can be provided by constructing food bridges or boardwalks.

Weather Station- Schools with very little space in their schoolyard can still benefit from a small weather station. Students can keep records of temperature, rainfall, barometric pressure, windspeed, directions, etc. They can compare their records to weather reports and wildlife life cycles. Equipment for weather stations can range from home made to highly technological.

Bumblebee by The Nature Conservancy

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c. Correlation of Project WET and Project WILD Activities to the Waccamaw Watershed Teachers' Guide [30, 31]

CHAPTER 2. WATERSHEDS

- Color Me a Watershed by Project WET
- Imagine! By Project WET
- The Incredible Journey by Project WET

CHAPTER 3. NATURAL ENVIRONMENT

- Fire Ecologies by Project WILD
- Thicket Game by Project WILD
- Stormy Weather by Project WILD

CHAPTER 4. ECONOMY

- Wet Work Shuffle by Project WET
- Wildwork by Project WILD

CHAPTER 5. WATER QUALITY

- Aquatic Insects by Coastal Carolina University
- Sum of the Parts by Project WET
- Water Bill of Rights by Project WET
- Water : Read All About It! By Project WET

CHAPTER 6. WILDLIFE

- Move over Rover by Project WILD
- Animal Poetry by Project WILD
- Back from the Brink by Project WILD

CHAPTER 7. OUR ENDEMIC SPECIES

- Here Today Gone Tomorrow by Project WILD

Links for Further Research:

- **Project WET (www.projectwet.org)**
- **Project WILD (www.projectwild.org)**

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d. Endnotes

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[30] The Watercourse and Council for Environmental Education. Project WET (1995)

[31] Council for Environmental Education. Project WILD (2010)

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e. Vocabulary

Adapted- Adjusted or modified some characteristic because of a change in living conditions.

Animal Operation- A company that raises animals for commercial purposes (meat, eggs, etc).

Assessment- A study to evaluate a certain condition, in this case environmental or chemical.

Basin- Another word for watershed. See watershed below.

Biodiversity-The range of organisms present in a particular ecological community or system.

Buffer- Something that reduces impact or protects against harm, usually by interception.

Carnivorous- A meat-eater.

Clearcut- A forestry practice where all trees in an area are cut for harvest. New trees are usually replanted.

Contaminated- Something that is impure because of an outside influence.

Conversion- A change in the nature, form, or function of something.

Corridor- A narrow passage between larger areas of land.

Decomposition- The break-down of organic materials.

Dialect- A variety of a language, that differs because of where one lives or social status.

Discharge- To pour something.

Ecosystem- a localized group of interdependent organisms together with the environment that they inhabit and depend on.

Elevation-the height above a specific reference point which is usually sea level.

Endangered-Threatened with extinction. Extinction is when a species no longer lives on earth.

Endemic- a species of organism that is confined to a particular geographic region such as an island or river basin.

Erosion- The process by which the earth is worn away.

Fertilizer- A chemical or organic substance used to help plants grow.

Habitat- The natural conditions and environment in which a plant or animal lives, e.g. forest, desert, or wetlands.

Influential- The ability for something to have a strong effect on something else.

Landfill- A place where trash is layered with natural soil to help decomposition.

Larvae- The immature, wingless form of an insect.

Limestone- sedimentary rock formed from the skeletons and shells of ocean organisms that consists chiefly of calcium carbonate.

Native- Being original to a certain environment or location.

Naval Stores- Products used in shipbuilding, especially, resin, turpentine pitch and wooden masts.

Omnivore- An animal that will feed on many types of food, including both plants and animals**.**

Peat- A type of soil consisting of partially decomposed organic debris, usually saturated with water.

Pesticides- A chemical mixture for destroying plant or animal pests.

Photosynthesis- The complex process by which plants use the sun, carbon dioxide and chlorophyll to make energy.

Plantation- A large farm or estate where a crop is cultivated. It could be tobacco, pine trees, or corn, etc.

Prescribed Fire- Fire that is set intentionally as a management tool in forests. Prescriptions for fires set out the environmental conditions needed to set a safe and controllable fire.

Pulpwood-a soft wood that is used to make paper, e.g. aspen, pine, or spruce**.**

Region- A part of the earth, usually defined by natural features.

Seasonal- Something that happens in rhythm with natural seasons.

Sediment- Mineral or organic material that is deposited by water, air or ice.

Swamp- An area of land, usually fairly large, that is always wet and is overgrown with various shrubs and trees.

Threatened- To be in danger.

Watershed- The land area that drains into a particular lake, river, or ocean.

Waterway- A river, canal or other body of water, sometimes used as a route for travel.

Wastewater- Water that has been used in washing, manufacturing or sewage disposal.

Wooden Navy Ship by UNC Chapel Hill