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**Wetlands – What’s the big deal?  
A worldwide and NC perspective**



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*BAE 495: Applications of Ecological Engineering  
Spring 2009*

**Lecture Outline**


- What is a wetland? – definitions and examples
- Humans and wetlands
- Types of NC wetlands
- History of wetland loss in NC  
- contribution of agriculture, roads, development
- Values of wetlands

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**What is a wetland?**

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**Wetlands around the world**



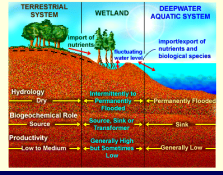
Everglades (Florida, USA)      Peat bog (Spain)      Arctic sedge/moss wetland (Canada)

Fen (UK)      Wet Meadow, Colorado (USA)      Hardwood Swamp, NC (USA)

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**Wetlands are often ecotones**

- Transition between uplands and deepwater aquatic systems
  - Complex ecology
  - Complex hydrology
- Not studied extensively before the 1960s. Require multi-disciplinary approach for understanding
  - Biologists/Naturalists    Ecologists    Hydrologists  
Soil Scientists    Engineers



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**Wetlands defined**

- EPA/USACE

For regulatory purposes under the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." [taken from the EPA Regulations listed at 40 CFR 230.3(t)]

<http://www.epa.gov/owow/wetlands/what/definitions.html>

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## Wetlands must have

- USACE - Hydrophytic vegetation, hydric soils, and inundated/saturated to the surface (within 12 in) for 5-12.5 % of the growing season - 12-30 days
- <http://www.saj.usace.army.mil/permit/documents/87manual.pdf>
- Much debate
- Which is the most important component?
  - Hydrophytic Vegetation
  - Hydric Soils
  - Hydrology

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## Humans and wetlands

- Many cultures have embraced wetlands and depend on them economically

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## Cultural activities that have depended on or embraced wetlands (examples)

Ma'Dan - SE Iraq



Lake Titicaca Peru

Uros - Make floating reed islands



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## Cultural activities that have depended on or embraced wetlands (examples)



Camarguais in Southern France



Cajuns in Louisiana

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## Cultural activities that have depended on or embraced wetlands (examples)



Cranberry bogs in Massachusetts , USA



Rice production in SE Asia

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## Humans and wetlands

- Others viewed or view them as sinister, forbidding, or dangerous with no economic value
- Think about and list negative images embedded in societies about wetlands



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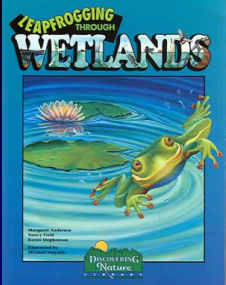
### Common Images

Malaria mosquito  
(Anopheles spp. 1.5-2 mm)

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### Difficult travel through swamps



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### Quotables!:

- About surveying the Great Dismal Swamp in NC/VA
 

[a] horrible desert, the foul damps ascend without ceasing, corrupt the air and render it unfit for respiration... Never was Rain, that cordial of Life, found more necessary than in this Dirty Place - Col. William Byrd III (1674-1744)
- Stories – Bog-eyman
 
- Phrases
  - “Bogged down” in details
  - “Swamped” with work

1 – From Mitsch and Gosselink (1993) Wetlands.

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### WETLAND TYPES IN NC

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### Wetland types in NC

- For the purposes of this lecture – break the wetlands into 3 main groups
  - Riparian
  - Non Riparian
  - Tidal

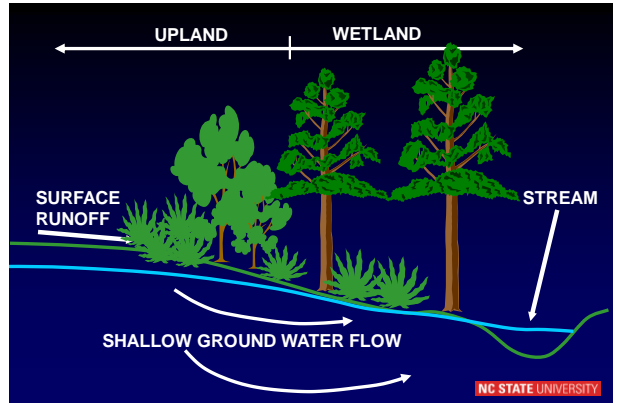
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## Riparian Wetlands

- Associated with streams and floodplains
- Bottomlands, floodplains, swamps
- Inputs: rainfall, surface run-on, stream overflow, groundwater discharge
- Outputs: stream discharge, ET, run-off



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Cypress Swamp



Floodplain Marsh



Black Gum with Sedges

## Riparian Wetlands

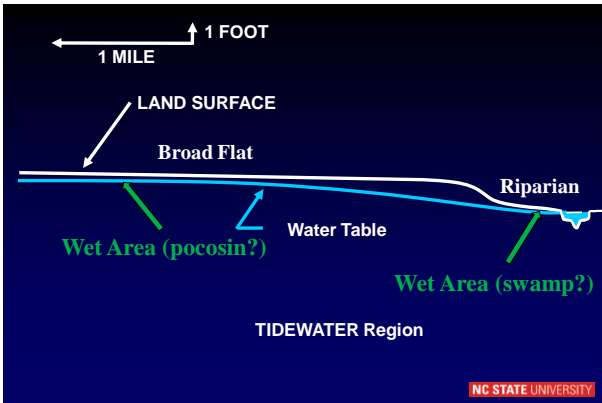
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## Non-Riparian Wetlands

- Broad flats (Pocosins, Non-riverine wet hardwood wetlands, etc.)
- Carolina bays
- Inputs: rainfall, small amounts of lateral subsurface flow and surface run-on (upslope)
- Outputs: ET, surface runoff, minor vertical seepage, and very minor subsurface flow



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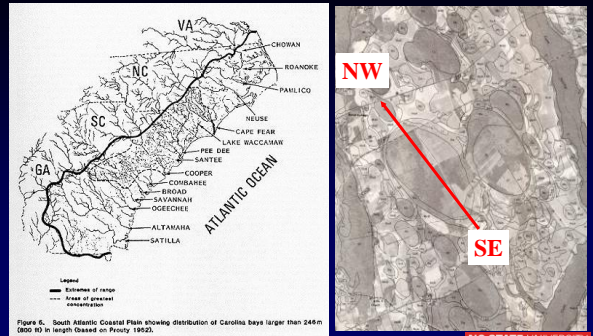
Bottomland Forest  
Mixed Hardwood and  
Pine Forest on Broad Flats



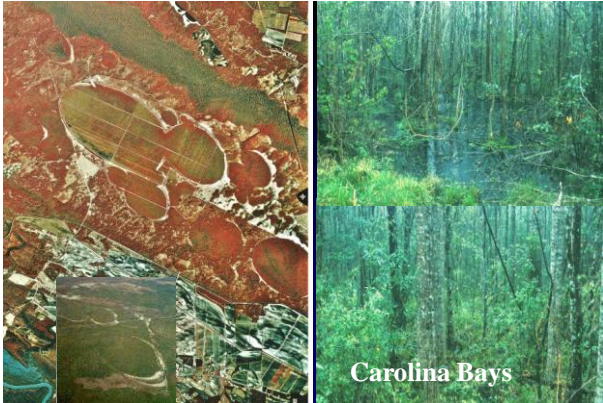
Pocosins on Broad Flats

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## Carolina Bays



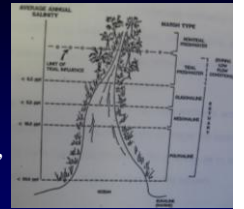
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Carolina Bays

## Tidal Marshes (Extreme Eastern NC)

- Tidal Freshwater marshes
- Tidal Salt marshes (upper/lower marsh)
- Inputs: rainfall, small amounts of lateral subsurface flow and surface run-on (upslope), daily tidal inflow, tidal surge
- Outputs: ET, surface runoff, minor vertical seepage, very minor subsurface flow, tidal outflow



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Tidal Freshwater marsh

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Tidal Creek

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**Early Settlement and Drainage in eastern North Carolina**

- 1584 First settlement on Roanoke Island (Lost Colony)
- 1607 First permanent settlement, Jamestown
- 1700 Settlements throughout eastern N. C. and southern Virginia

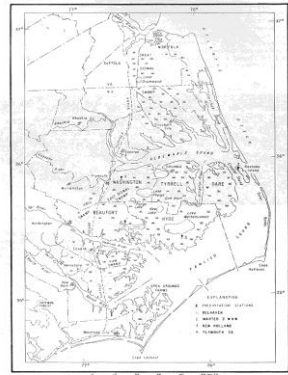
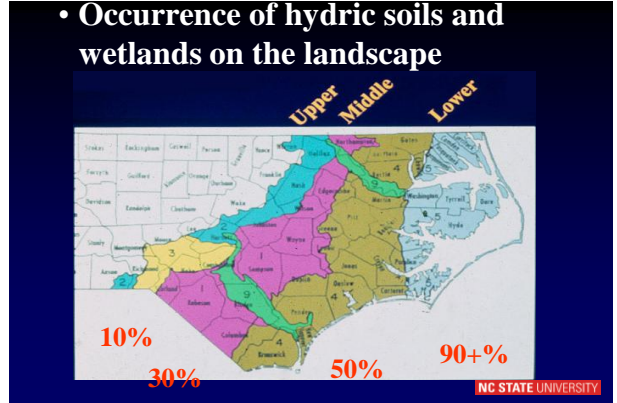


Figure 2.--Regional setting of the Albemarle-Pamlico peninsula.



**What is a Hydric Soil??**

- SCS, 1987:
  - “a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part”
  - Where there is hydric soil – the site must have been wet for a long time



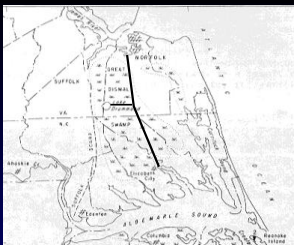
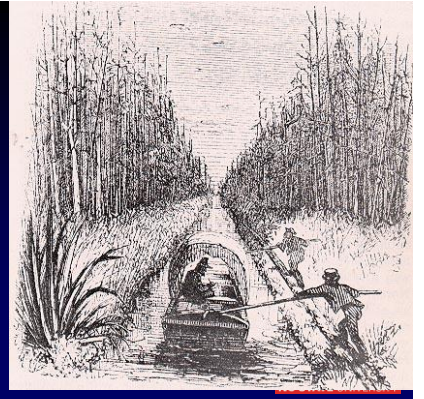
## History Drainage in eastern North Carolina

- 1763 - George Washington formed company with five investors and obtained rights to 40,000 acres of Dismal Swamp with intention of draining it. (Dug one canal named Washington Ditch).
- 1784 - Dismal Swamp canal was proposed for navigation from Norfolk to Albemarle Sound.

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Construction began in 1793 and was completed in 1805. Canal was 20 miles long, 5 feet deep and 20 feet wide.

(Dug entirely with hand labor).



Dismal Swamp Canal

Wetter

Drier

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## History Drainage in eastern North Carolina

~ 1760 Lake Phelps observed to be higher in elevation than surrounding land.

It was proposed about 1780 to drain the lake and farm the 30,000 acre lake bed.

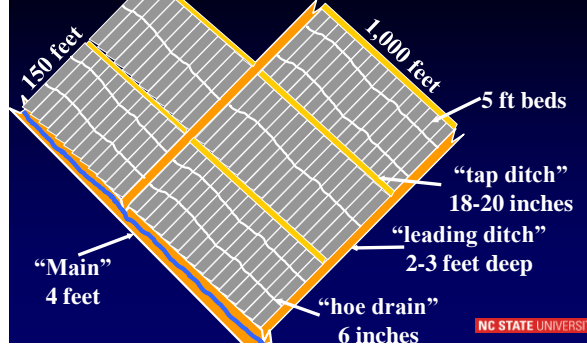


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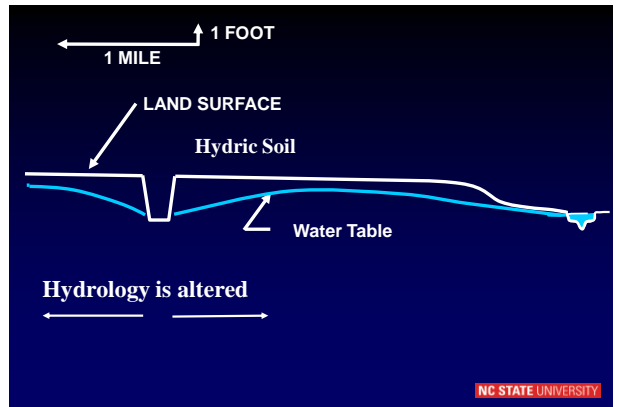
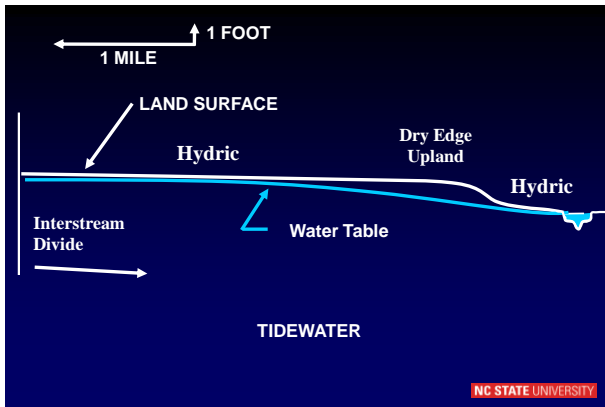
Tough to grow crops on these broad flats (majority of the landscape in tidewater region)



## Drainage System observed by Ruffin in 1836 in Dismal Swamp area of North Carolina



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### Early drainage impact in Washington County, NC

The original extent of wetland coverage and the effect of widespread drainage is evident in Washington County, NC. Originally, wetlands covered over 400,000 acres or about 61 percent of the land area of Washington County. Large-scale drainage began in early to mid 1780 with the construction of a canal 60 miles long and 20 feet wide to drain the wetlands north and east of the Lake. (Washington County Historical Society, 1970). A number of more ditches leading into the main canal were designed to drain 100 to 150,000 acres of wetlands so that the land could be plowed (Frost, 1943). Today, about 34 percent of Washington County's original wetland acreage remains for agricultural use.

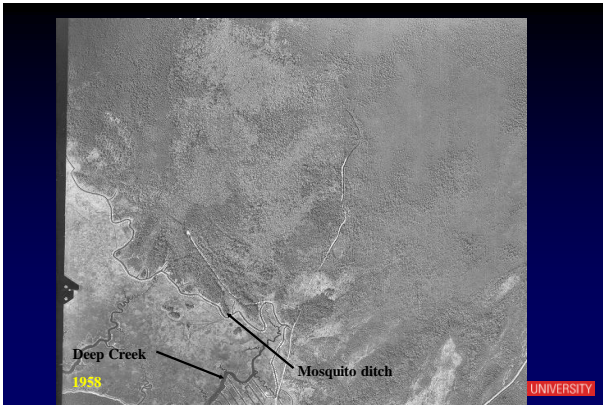
Figure 3. Extent of wetlands in Washington County, N.C., circa 1780 (left) and 1980 (right). (Source: U.S. Fish and Wildlife Service, 2004 and Frost, 1943; copyright 1980)

### History Drainage and Channelization Policy

- Many federal and state initiatives to drain wetlands through the years
  - Literary Fund – proceeds of drained lands toward education
  - Commerce
  - Roads
  - USDA Drainage specialists
- Established drainage districts - Watershed Protection and Flood Prevention Act 1954 – PL 566 authorized USDA (SCS) to plan and construct drainage projects in cooperation with State and Local Districts
  - Flood control
  - Increase agricultural production
- Federal Flood Control Act 1944 authorized Corp of Engineers to construct primary drainage outlets and flood control projects
- More recently – developments and roads




### Drainages of the Albemarle Pamlico Peninsula, 1940



### Drainage of Wetlands for Agriculture



- Prior converted wetlands drained with ditches typically spaced at 330 ft (100 meters)
- Fields crowned to improve surface runoff



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### Drain "Tiles"

- Installed end-to-end by hand or with trencher
- Gaps between tiles allowed infiltration of water
- Laid on slope to move water to outlet

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**Construction of Ditches**


**Removal of Native Vegetation**

**Smoothing of Surface**

**Crowning of Surface**

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### Modern Drainage Systems



Drainage ditch      Subsurface Drainage Pipe      Control Structure (controls drainage outflow)

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<http://www.extension.umn.edu/distribution/cropsystems/images/774004.gif>

Figure 1. UNKIA-ARIS profitability per acre with tile drainage systems with best-drainage system. Source: agronomy.commercial.com

Figure 2. A tile-drainage system installed in a field.

**DRAINMOD**

Figure 3. A tile-drainage system installed in a field.

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## Why would anyone want to farm a wetland??

Poorly drained soils rich in organic matter –

**Result - highly productive farmland when drained**

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## NC Wetland History

- 95% NC Wetlands in coastal plains (2.4 million ha)
- 50% have been altered
- 1950 – 1980s Causes of alteration
  - 53% Forestry
  - 42% Ag
- Swampbuster (1985) - protect wetlands on farm not planted with crops to be eligible for USDA farm benefits
- 1992-1997 Causes of alteration
  - 49% development
  - 26% Ag (Cashin et al. 1992)

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## Who cares if we drain wetlands?

We know now that wetlands have Value

- Are all wetlands of equal value?
- What are some wetland values?
- Which values are associated with which wetlands?
- Should all be protected equally?

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## Group activity – List wetland values (be sure to associated the values with a wetland type)

<p><b>Societal</b></p>	<p><b>Ecological</b></p>
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## Homework Assignment – Due March 27th

- Question 1.** Describe three types of wetlands in NC and the wetland values associated with each. Which of these types of wetlands do you think are most important to the well being of N.C.'s economy and well being of its citizens? Note: (do not use "riparian or non-riparian" as a type. Instead, use the wetland ecosystems found within those groups). (1.5 pages maximum)
- Question 2.** A common question raised in wetland restoration or creation is the relationship to global warming. Some think more wetlands will speed global warming. What is the argument based upon and do you think it is a valid concern? (Hint – do some research and consider biogeochemical reactions within wetlands versus current trends in wetland loss). (1 page maximum)
- Helpful links (to get you started):
  - EPA wetlands website: <http://www.epa.gov/towww/wetlands/>

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