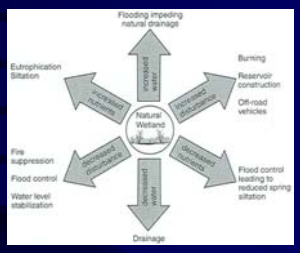
Wetland Losses and Human Impacts



Matthew J. Gray
University of Tennessee

Distribution of North American Wetlands

Peatlands of Alaska and Canada

Prairie Potholes

Sacramento Valley

Hudson and James Bay Wetlands

Great Lakes Wetlands

Coastal Wetlands

Everglades

Playa Lakes

MAV

30% of World's Wetlands

Pre-Settlement in Lower US
89 mil ha

Current North American Wetland Estimates

United States: 3.5% of U.S. Area

- •Lower 48 and Hawaii =42 mil ha (89 mil)
- •Alaska =69 mil ha 53% Loss**

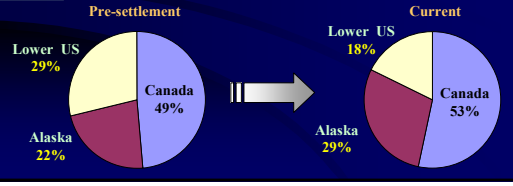
=111 mil ha

Canada: 14% of Canada

=127 mil ha

Manitoba (22.5)
Ontario (29.2)
= 51.7 mil ha
41%

=238 mil ha



Current Acreage of Wetland Types in the United States

1997, 2007

Type of Wetland	Area in United States (×10⁶ ha)
Coastal wetlands	
Tidal salt marshes	1.9
Tidal freshwater marshes	0.8
Mangrove wetlands	0.5
Inland wetlands	
Freshwater marshes	27
Peatlands	55
Freshwater swamps / Riparian systems	25
Total	111

(x 1 mil ha)

- US Wetlands Dominated by Peatland
  - Alaska (Minnesota → Michigan)
- Forested Wetlands Most Common
  - Lower 48

	Peatlands*	Marshes	Swamps
Lower 48 states	3,700	9,932	25,138
Alaska	51,754	17,004	
Total	55,454	26,936	25,138

	Salt Marsh*	Freshwater Tidal Marsh*	Mangrove*
Atlantic Coast	669	400	
Gulf of Mexico	1,011	362	506
Pacific Coast	49	57	
Alaska*	146		
Total	1,875	819	506

(x 1,000 ha)

Estuarine wetlands are most common coastal wetland

Gulf of Mexico → Louisiana

Distribution & Characteristics of Peatlands

Precipitation > Evaporation

25-50%

Accumulation > Decomposition

Anaerobic

Fens

Sedges & Tamarack

pH > 5.0

Discharge

Bogs

Moss & Spruce

pH < 4.0

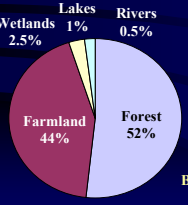
Recharge

Tennessee Wetlands

Approximately 3% of Land Area

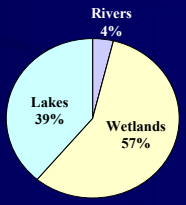
26.9 Million Acres ≈ 780,000 ac.

316,000 ha (0.8% of Lower US)



All Land Uses

Broad-leaved and needle-leaved Deciduous



Water Cover

Wetlands:
A Barrier to American Progress!

47 Million ha of Wetlands Lost in Conterminous United States

- **Swamp Land Acts of 1849, 1850, and 1860**
  - → Federal wetlands sold to states (26 mil ha)
- **USDA Agriculture "Conservation" Program**
  - → Drain wet "farmland" (23 mil ha) 1940s–70

4X Size of Tennessee!

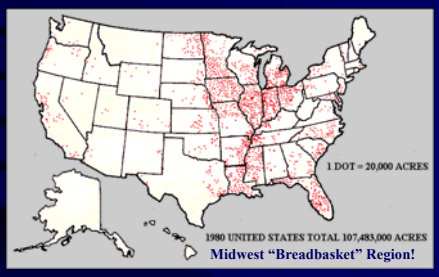
"…the 1.6 million acres of cutover cypress swamps in Louisiana must be put into their true function—agriculture. It is important to Louisiana, the South and Nation as a whole."

Sinister Image of Wetlands

State Wetland Losses

53% in Lower US

See Handout!



Midwest "Breadbasket" Region!

Most % Loss:

- Arkansas = 91%
- California = 91%
- Ohio = 90%
- Iowa = 89%
- Missouri = 87%
- Indiana = 87%
- Illinois = 85%
- Kentucky = 81%

Most Total Loss:

- Florida = 3.6 mil ha.
- Louisiana = 3.0 mil ha.
- Illinois = 2.8 mil ha.

Mississippi Alluvial Valley Wetland Losses

77% of Hardwood Bottomland Forests

8.5 Million ha

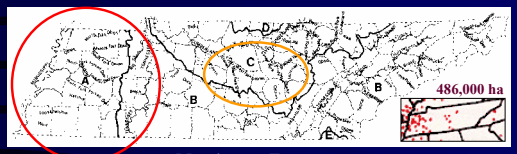
⇩

2 Million ha

Most Remaining Parcels are Seriously Fragmented

Tennessee Wetland Losses

60% Loss ⇔ 1.2 Million ac.



Most in west Tennessee

$1,000/ac

Does not Mean Cannot Destroy

State Legislation

"No Net Loss" Policy

Tennessee Wetlands Acquisition Act (1986)

Real Estate Transfer Tax ➡ $7 mil. annually to TWRA (⅔, ⅓)

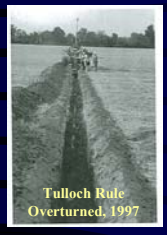
$67 Mil. ➡ Purchase 62,494 ac. wetlands

Human Influences on Wetlands

Draining Wetlands

#1 Loss of Wetlands

Mostly for Agricultural Use



Tulloch Rule Overturned, 1997

Drainage Ditch, Clay Tiles, Plastic Pipes

Midwest & SE

Pits & Pumps

Floating or PTO-driven Pumps

Restoration?

Human Influences on Wetlands

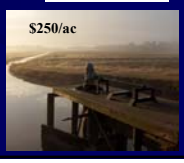
Deforestation

Agricultural Use Especially in SE

Many Hardwood Bottomlands cut First for Timber

Fragmentation

Cotton, rice, soybeans



$250/ac

Human Influences on Wetlands

Levees and Channelization

Flood Control Acts 1928–68

•Prevent Overbank Flow

MS River Levee

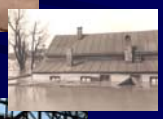
•Drain Adjacent Landscape Quickly

5X or 80%

Flood Control–Ironic!

Navigation & Transportation

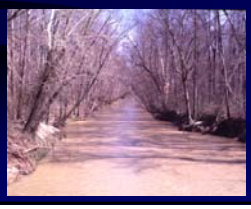
Intracoastal Waterway



Implications of Channelization and Sedimentation on Bottomland Hardwood Ecosystems

Aaron Pierce, Ph.D.
Nicholls State University

Channelization



- Straightens, shortens, and steepens stream channels
- Increases stream velocity and stream power
- Facilitates transport of sand to the river system
- Impacts hydrology and geomorphology

Hydrologic Impacts

- Alters timing, depth, duration, and frequency of flooding
- Disconnects rivers from the floodplain
- Can cause excessive ponding at confluences

Geomorphic Impacts

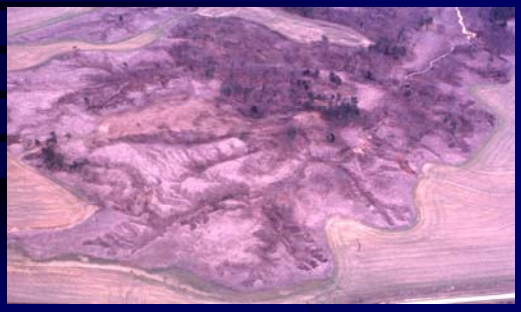
- Excessive sediment deposition, increased overbank flooding, increased water table, degrade bottomland systems

Root of the Problem

- Geology – Source of the sand
- Past and Present Land Use – expose the sand

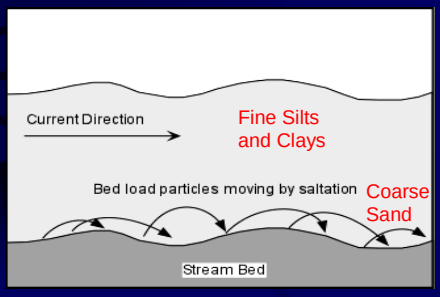
Thin Fertile Loess Layer with Underlying Sand

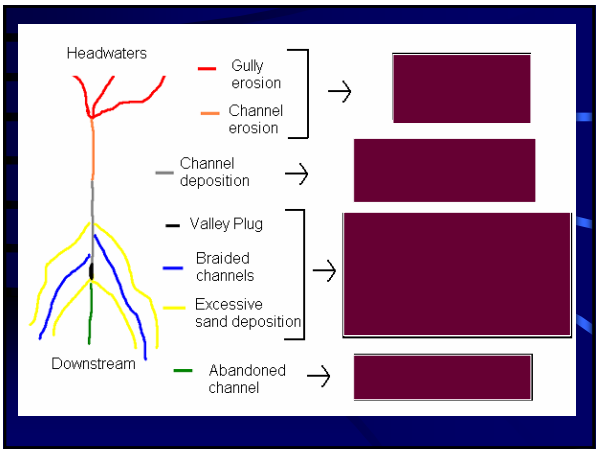
Gully Erosion

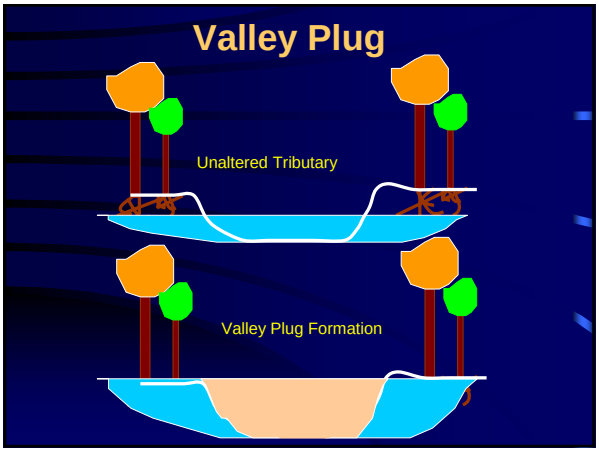


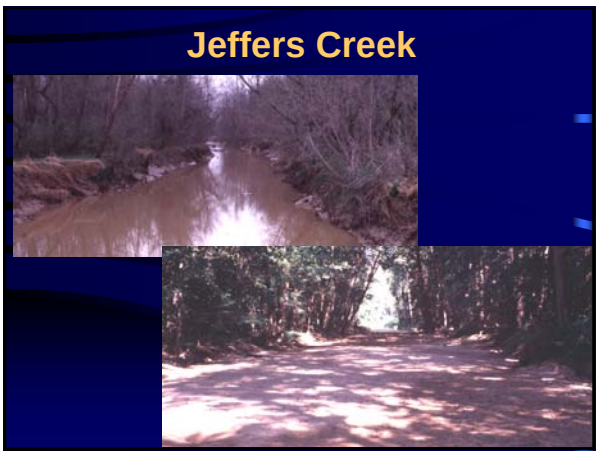
Channel Erosion

Bed Load Transport




Headwaters
Gully erosion
Channel erosion
Channel deposition
Valley Plug
Braided channels
Excessive sand deposition
Downstream
Abandoned channel


Valley Plug
Unaltered Tributary
Valley Plug Formation


Jeffers Creek

Valley Plugs

- Occur where sediment (sand) laden waters slow in velocity
- Debris jams and intersections of tributaries and rivers are common locations
- Completely plugs the channel
- During subsequent flows, the plug enlarges upstream as additional sand is deposited

Overbank Flooding

Ponding of Timber

- Increased water table and accelerated natural levee development encourage permanent ponding of timber

Excessive Deposition

Sand Splay

Telephone Pole Effect

Sanding of Timber

- Kills standing timber
- Alters tree species composition
- Buries productive soils and seed

Abandoned Channel

- Reduced flooding and sedimentation leading to a shift in species composition

Shoal Sites

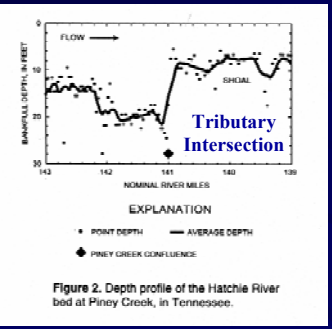
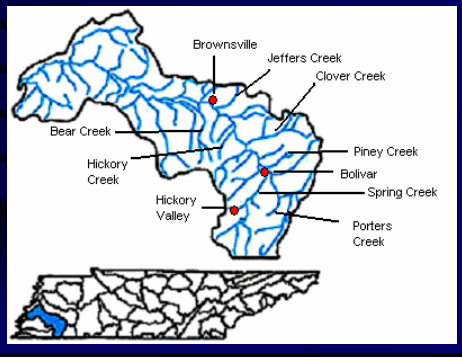


Figure 2. Depth profile of the Hatchie River bed at Piney Creek, in Tennessee.

- Shoal sites may be impacted in similar ways as valley plug sites but to a lesser extent
- Channel filling influences overbank flooding and the water table
- Crevasse splays cause excessive deposition in the floodplain

Location of Study Streams



Feldspar Clay Sediment Pads

Excessive Sand Deposition

Early Spring

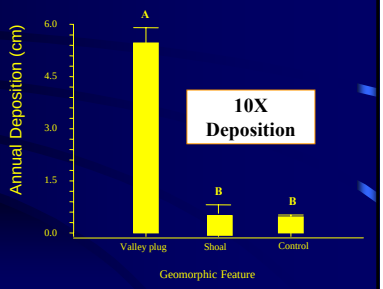
Fall

Mean Annual Deposition 2002-2004

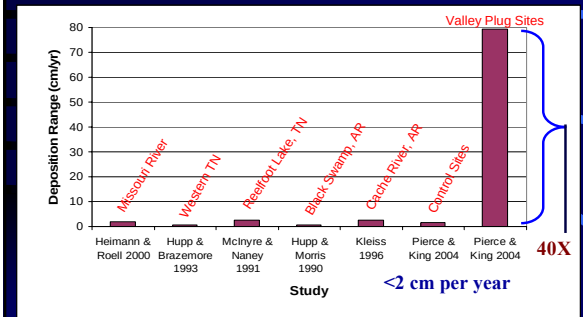
Valley Plug Sites (4):
- Mean = 5.46 cm/yr
- SE = 0.44

Shoal Sites (2):
- Mean = 0.57
- SE = 0.24

Control Sites (4):
- Mean = 0.46 cm/yr
- SE = .05

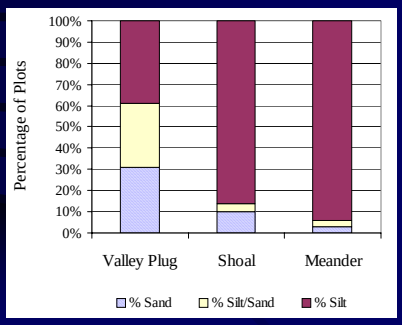


Maximum Annual Sediment Deposition Rates (cm/yr)



Deposition Texture Types

Larger Sediment at VP and Shoals!

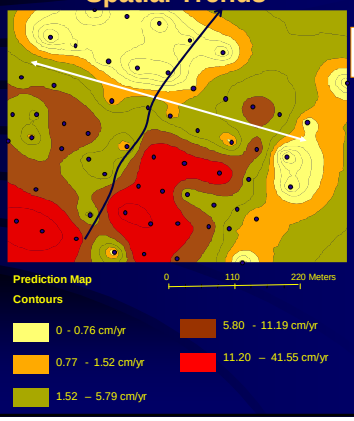


Spatial Trends

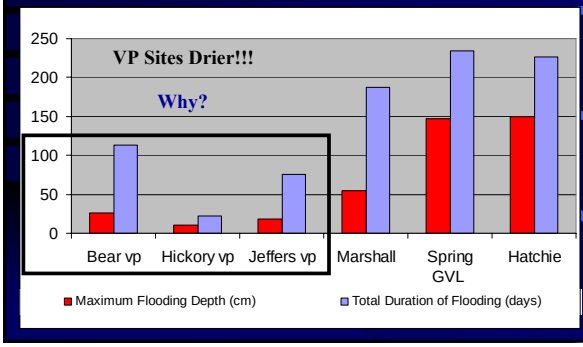
Deposition at Valley Plug

Perpendicular to channel

High Deposition (>1 cm/yr)

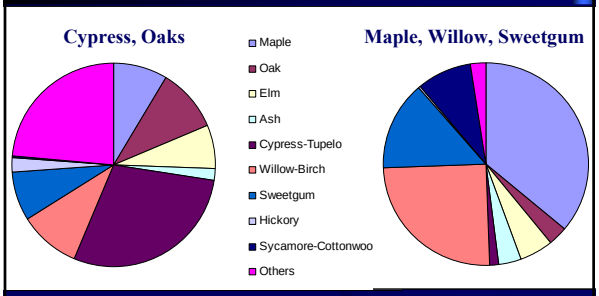


Maximum Flood Depth and Total Duration of Flooding



Abundance of Tree Species

Control Site — Valley Plug Site



Restoration? **Differences in Species Evenness!**

Human Influences on Wetlands

Filling Wetlands

Primary Causes

- Urban Development
- Highway Construction

Sedimentation

Erosion

Secondary

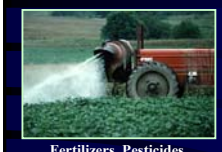
- Agricultural Runoff
- Bank Destablization

⅗ of World's Population on Coasts

95% CA

Human Influences on Wetlands

Water Pollution



Fertilizers, Pesticides

Cattle

Discharges
- •Chemical
- •Thermal

Erosion

Before

After

Human Influences on Wetlands

Peat Mining

World Peat Resources
1.9 Trillion Tons

- Russia (770 bT)
- Canada (510 bT)
- US (310 bT, 16%)

World Peat Mining

1) Finland
2) Ireland
3) Russia

"Non-renewable" Resource

Fuel

Annual Production

Fuel= 16.8 mil tons
Hort= 6.9 mil tons

23.7 mil tons

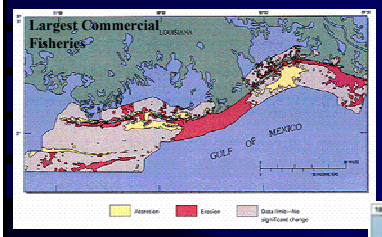
United States
676,000 tons
(Horticulture)

Horticulture

Human Influences on Wetlands

Louisiana Coastal Erosion

40% of Coastal U.S. Marshes



Channelization of MS River

- Reduced Sedimentation
  → Barrier Islands
- Increased Saltwater Intrusion

Rising sea levels

http://www.lacoast.gov/media/videos/index.htm

34 sq miles per year ⇒1900 sq miles (Delaware)
•15-65 ft inward loss per year

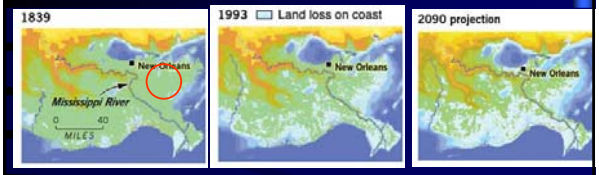
At the current rate of loss, by 2050, ⅓ of coastal LA will have eroded into the Gulf of Mexico!

Human Influences on Wetlands

Louisiana Coastal Erosion

30 min = 1 football field

1 mile = 1-ft buffer in storm surge



Hurricane Katrina

St. Bernard and Plaquemines parishes

30-sq miles loss in Breton Sound

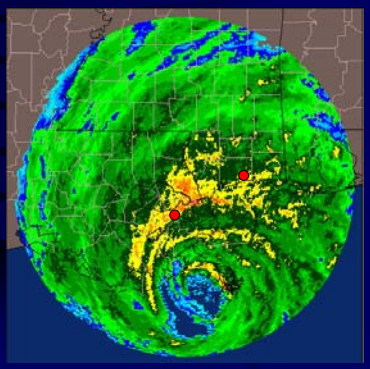
Storm Surge in Lake Pontchartrain
10-14 ft, 15-25 ft

Coastal Louisiana before Katrina

Chandeleur Islands

Hurricane Katrina

$29 bil Andrew



Category 4

29 August 2005

7:10 a.m. EDT

976 Deaths in LA, 218 in MS

≥$125 Billion Economic

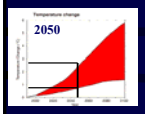
http://www.nwrc.usgs.gov/hurricane/katrina.htm

Coastal Louisiana after Katrina

Chandeleur Islands

Global Warming and Wetlands

Coastal Wetlands



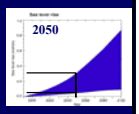
1 – 4.5°F

2-ft rise

43% of US coastal wetlands

(>50% in LA)

10,000 mi² land lost



50%: 25 cm

25% of all buildings <500 ft of coast lost in next 60 years

Global Warming and Wetlands

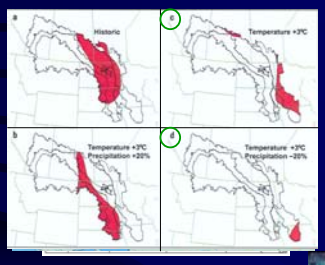
Prairie Wetlands

By 2100,

3 – 6°C

25% increase in evaporation

25% decrease in soil moisture



Losses

Up to 90% loss in semi-permanent wetlands

69% decrease in breeding waterfowl abundance

WETSIM Model
BioScience 55:863-872

Ideal Wetland Conditions will Shift East and North