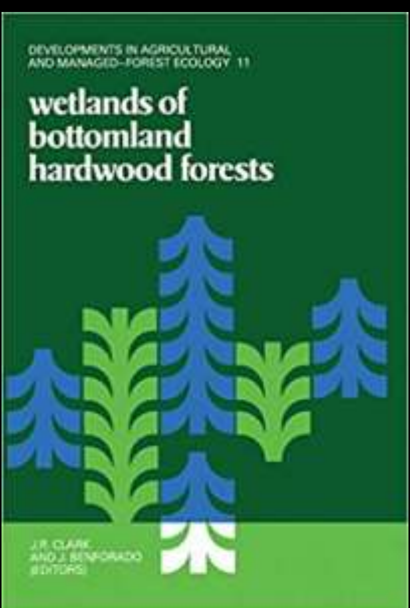
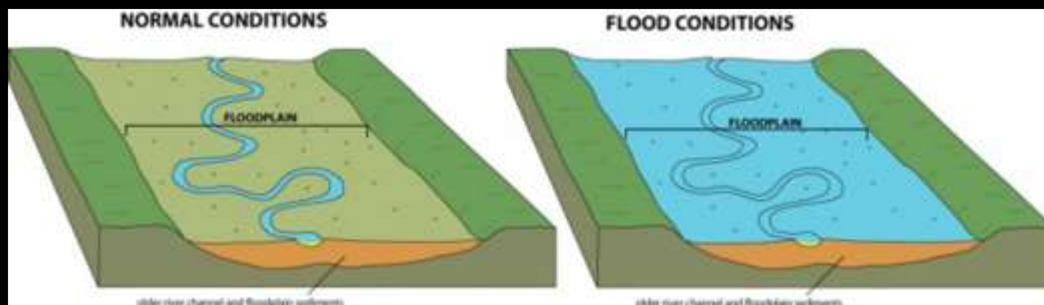
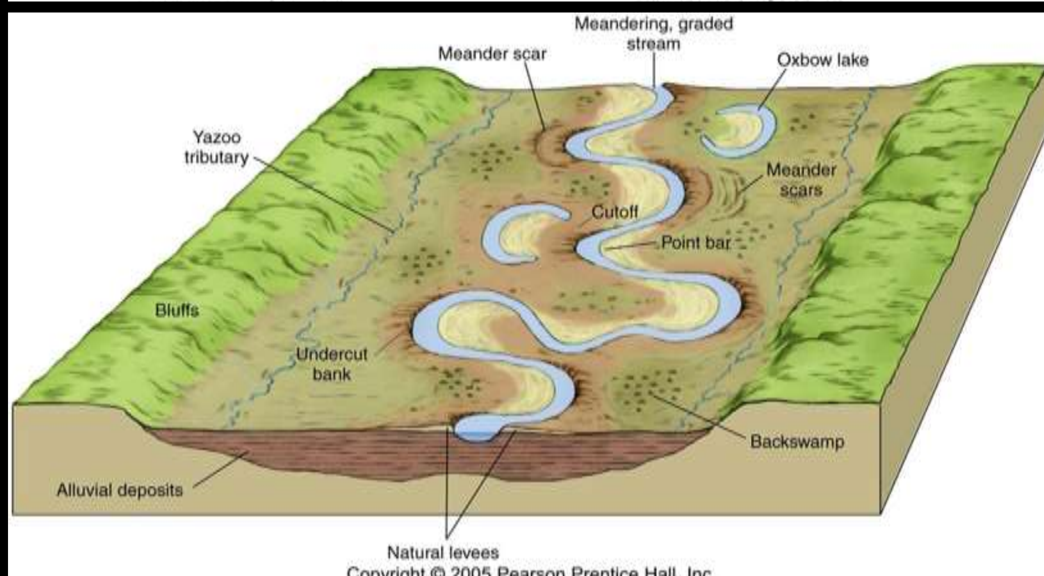
Center for Environmental Research at Hornsby Bend

Bottomland: Life on the Floodplain

Kevin M. Anderson, Ph.D.
Austin Water – Center for Environmental Research







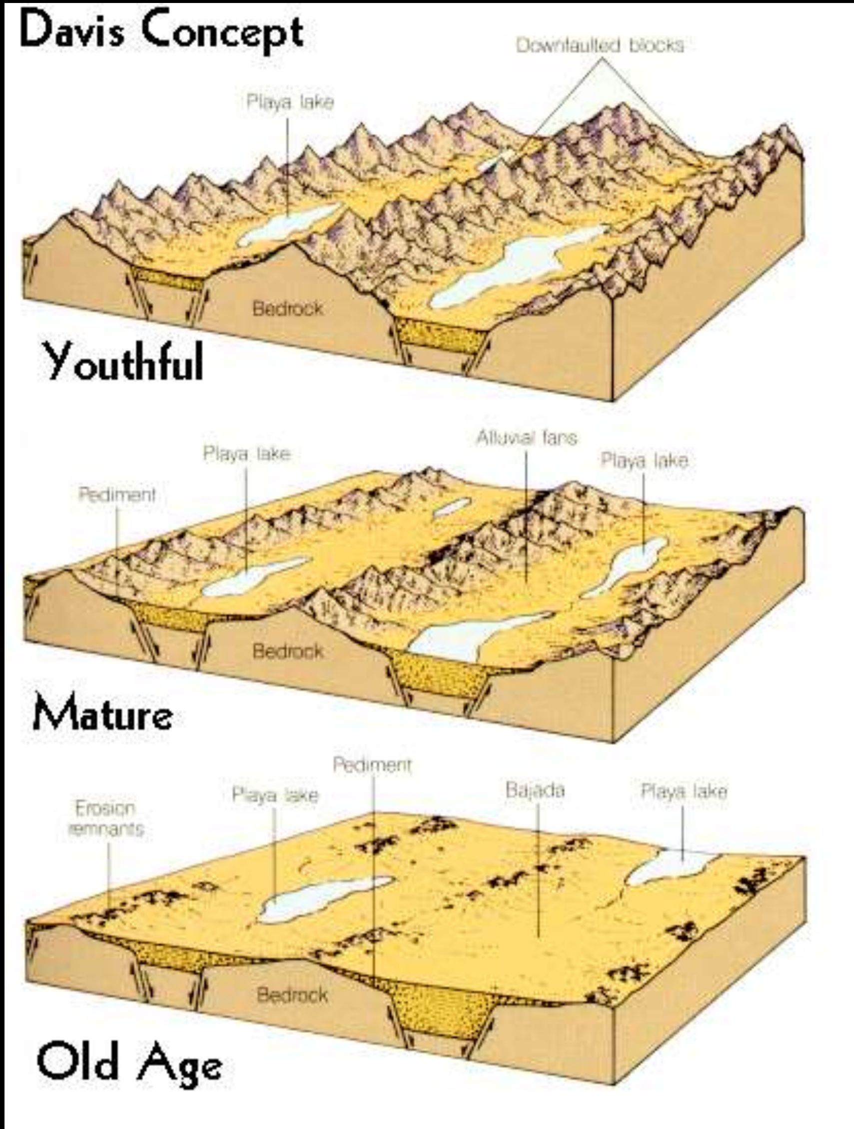
Flowing Water and Erosion – Earth Writing

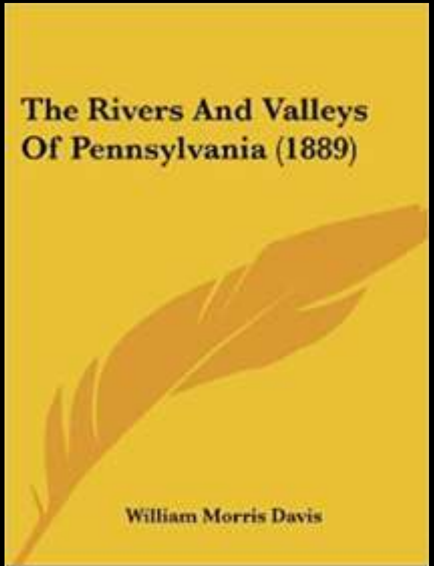
William Morris Davis (1850 - 1934) - American geographer, geologist, geomorphologist, and meteorologist, often called the "father of American geography".

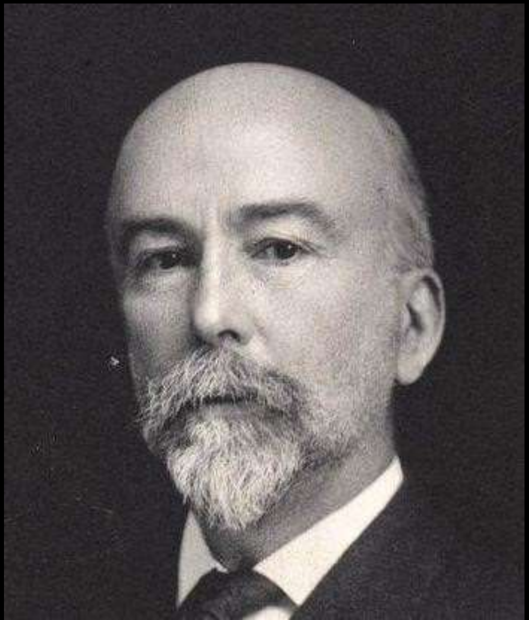
The Geographical Cycle – Erosion Cycle

His most influential scientific contribution, first defined around 1884, which was a model of how rivers create landforms.

Flowing water always wants to carry a sediment load





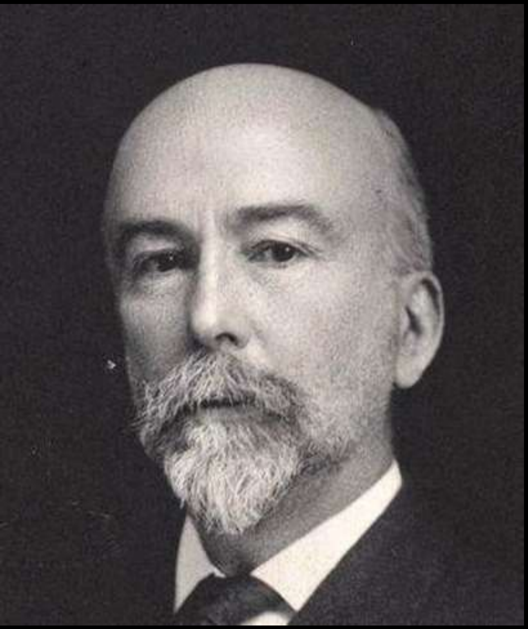


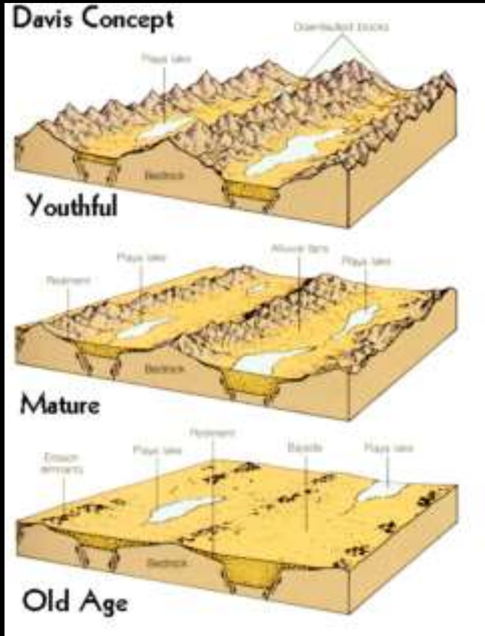
Waterways: The Life of a River – Physical Geography - Abiotic

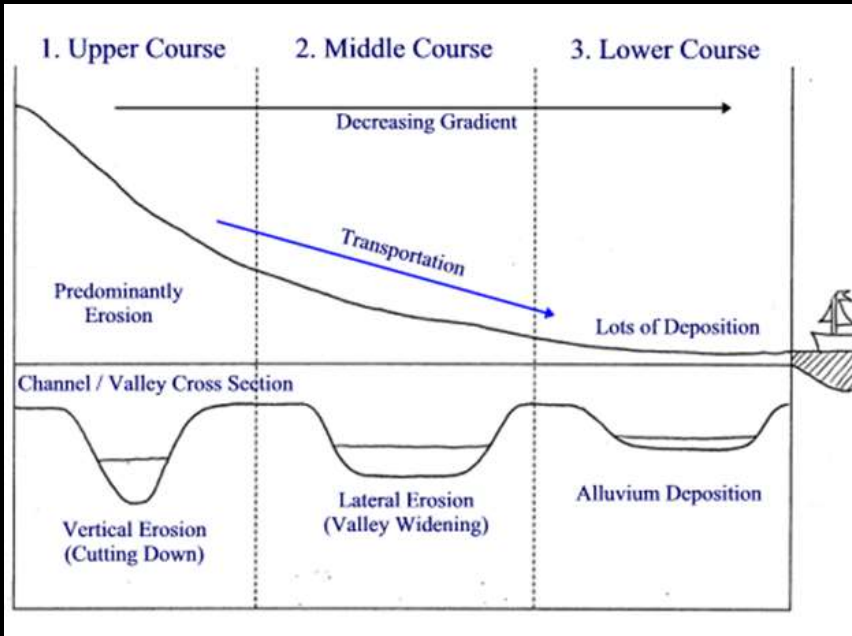
Luna Leopold wrote that Davis "viewed the river system as having a life of its own -

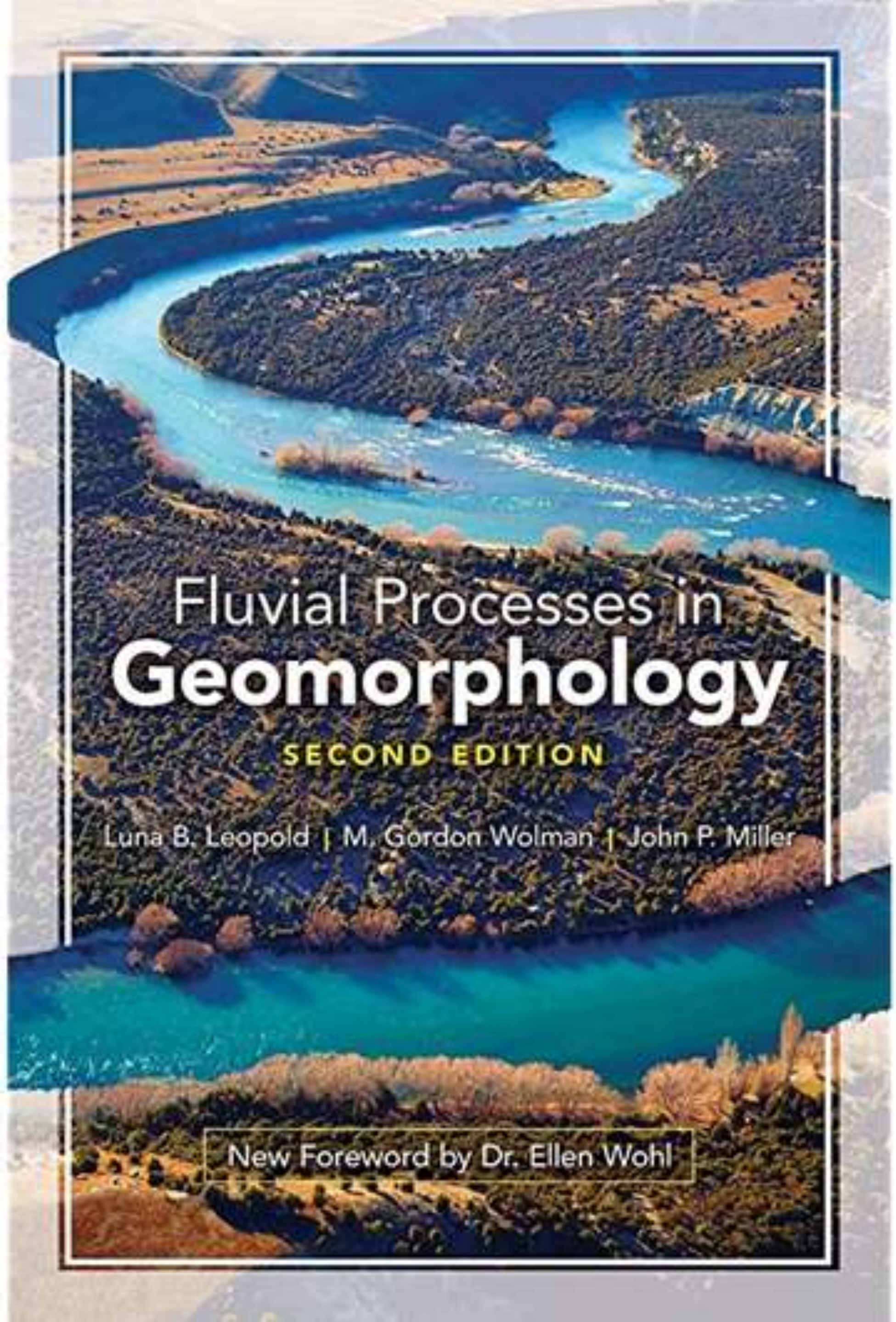
- Its youthful headwaters are steep and rugged.
- In its central part, it is mature, winding sedately through wide valleys adjusted to its duty of transporting water and sediment.
- Near its mouth it has reached, in its old age, a nearly level plain through which it wanders in a somewhat aimless course toward final extinction as it joins the ocean that had provided the sustaining waters through its whole life span."

Flowing water always wants to carry a sediment load







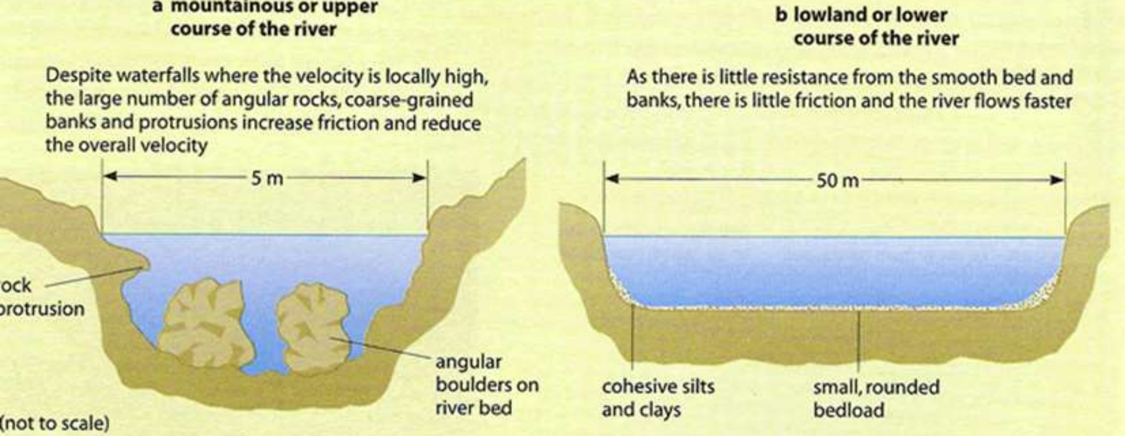


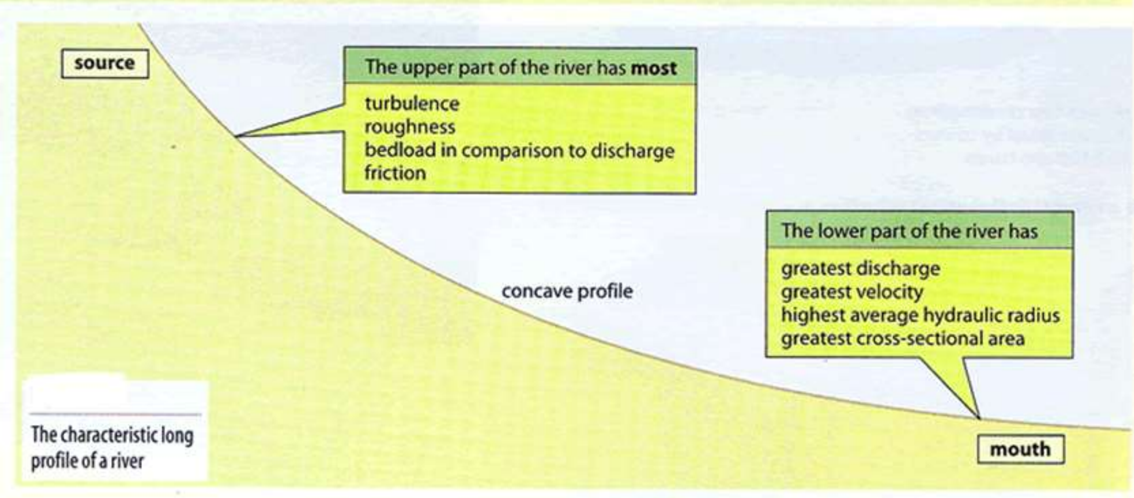
Fluvial Geomorphology

the study of how moving water shapes a landscape over time

Flowing water always wants to carry a sediment load

Sinuosity is inversely proportional to slope





How the abiotic river system changes downstream

"Downstream Change of Velocity in Rivers"

Apparent vs. Mean Velocity

Because river slope generally decreases in a downstream direction, it is generally supposed that velocity of flow also decreases downstream.

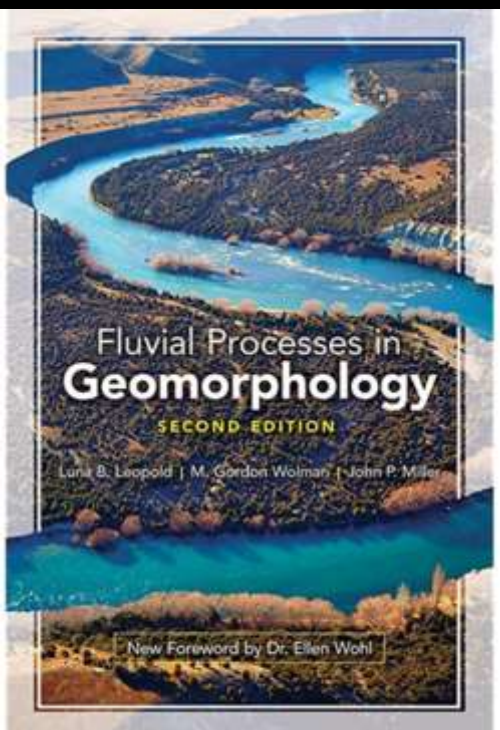
…mean velocity generally tends to increase downstream.

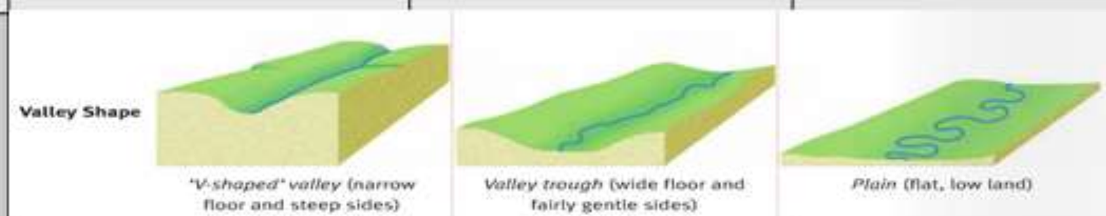
Waterways - A Fluvial Life (Davis and Leopold)

The Upper Course: steep and rugged

The Middle Course: winding sedately through wide valleys

The Lower Course: a somewhat aimless course toward final extinction

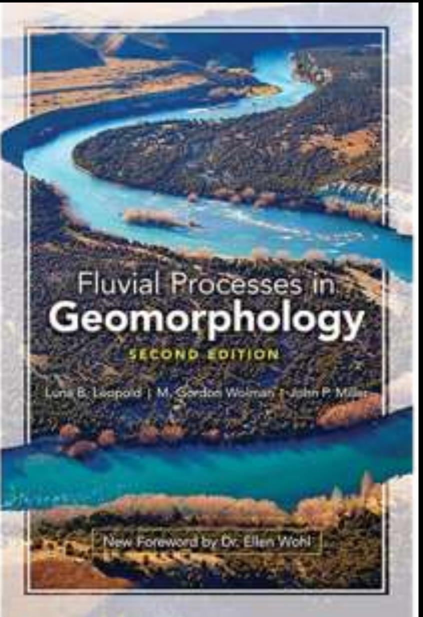


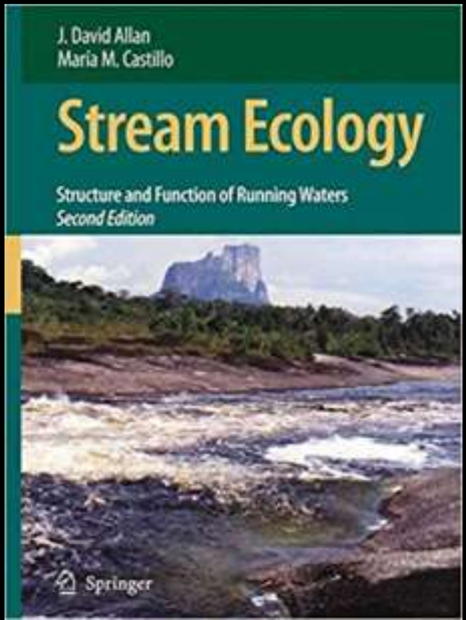
Course Stage	Upper Course Youth Stage	Middle Course Mature Stage	Lower Course Old Age Stage
Slope			
Main processes	Hydraulic Action Abrasion **Erosion**	**Erosion** and **Deposition**	**Deposition**
Valley shape			
Main features	V-shaped Valleys Interlocking Spurs Waterfalls	Meanders and Ox-Bow lakes	Deltas Levees Flood Plains (and m+ob lakes)

Fluvial Transportation and Ecology

Biotic and Abiotic Loads

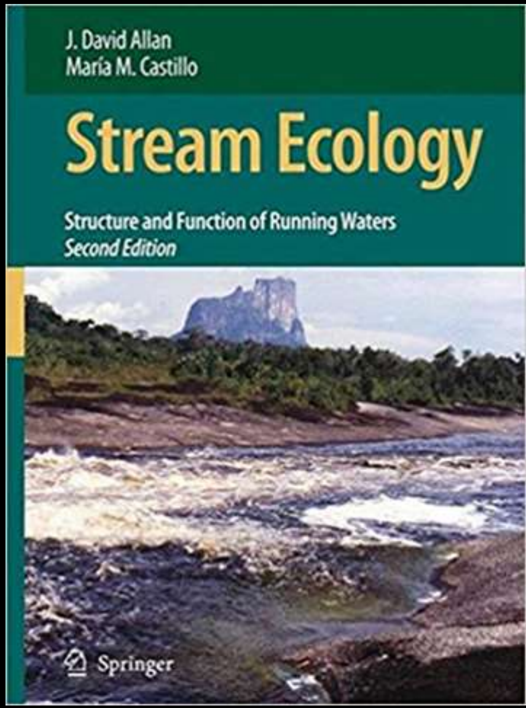
- Rivers transport three main materials downstream – water, sediment, and organic material.
- Fluvial Geomorphology - the abiotic components – water and sediment – most directly impact the shape of the river channel.
- Aquatic Ecology - the biotic components of a river's transported load range from dissolved organic matter to large woody debris.

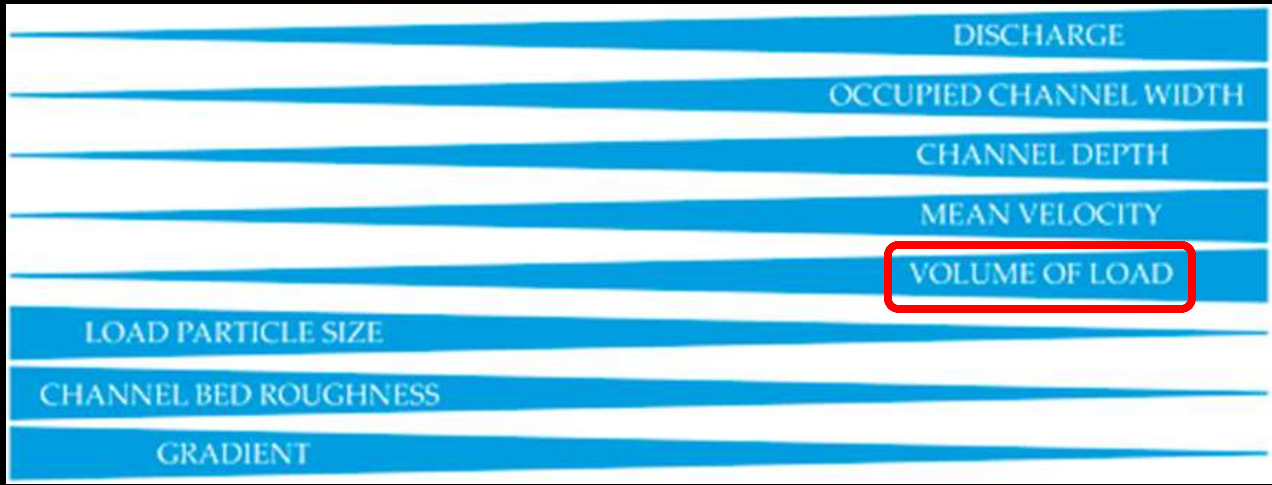




Dissolved Organic Matter (DOM)

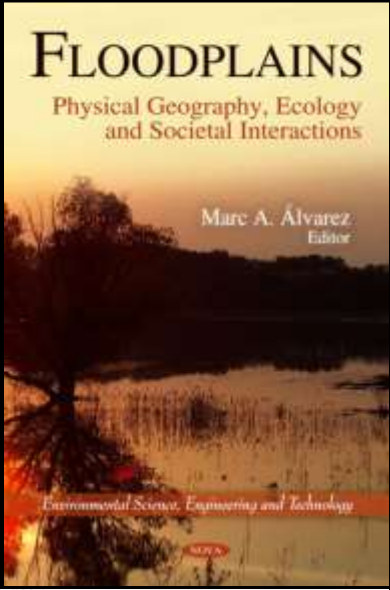
- Very small particles (<0.5 microns in diameter) but the fundamental component of the organic material in rivers.
- Sources: some of it enters via subsurface drainage and originates from terrestrial decomposition processes - other sources are detrital leaching and exudates and excreta from aquatic organisms. [Everything Poops!]
- DOM tends to increase in concentration downstream. The highest levels occur in blackwater rivers, especially those draining peat swamps, which are rich in humic substances that color the water.
- DOM is consumed directly by microorganisms or filter feeders

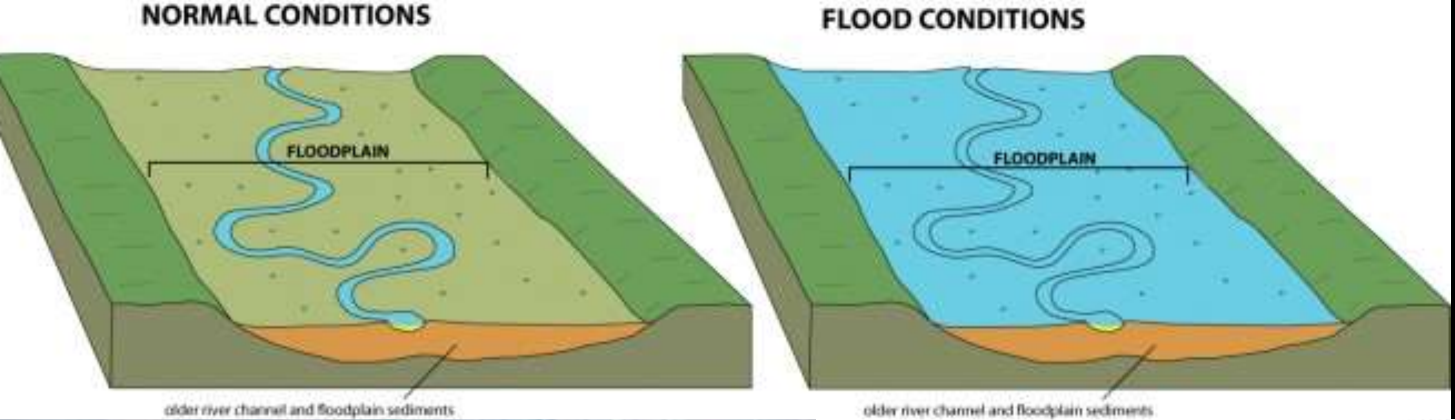


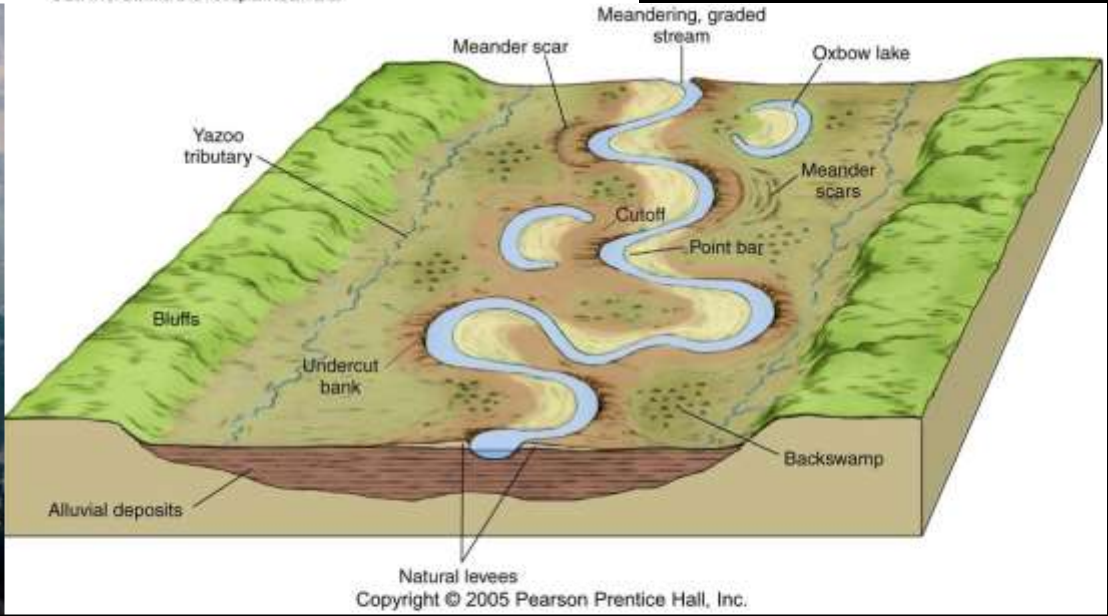


Fluvial Geomorphology - Floodplains and Levees

- A floodplain is a low-lying plain on both sides of a river that has repeatedly overflowed its banks and flooded the surrounding areas.
- When the floods subside, alluvium is deposited on the floodplain.



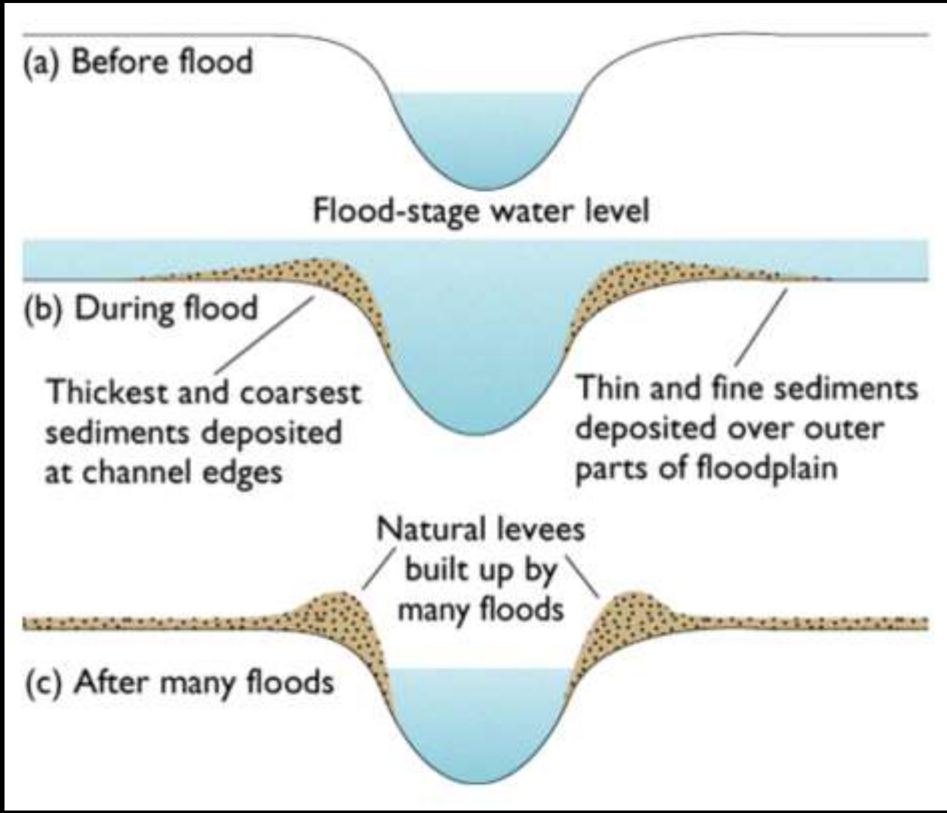




Floodplains and Natural Levees

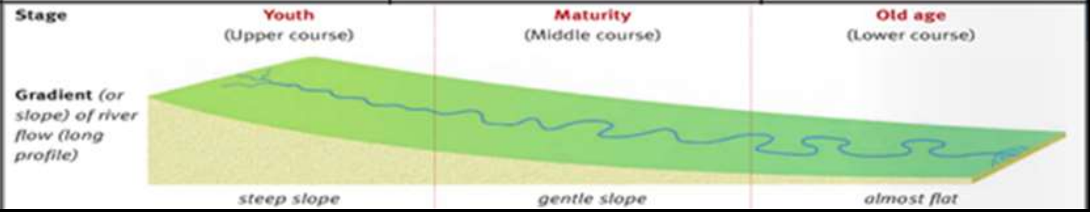
The larger suspended material, being heavier, is deposited at the river banks while the finer sediments are carried and deposited further away from the river.

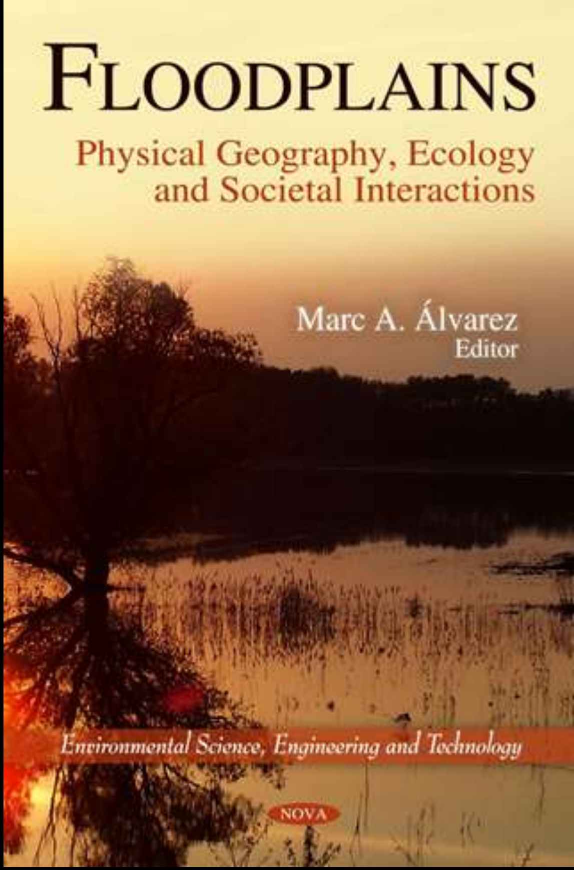
The deposition at the river banks build up into embankments called levees.

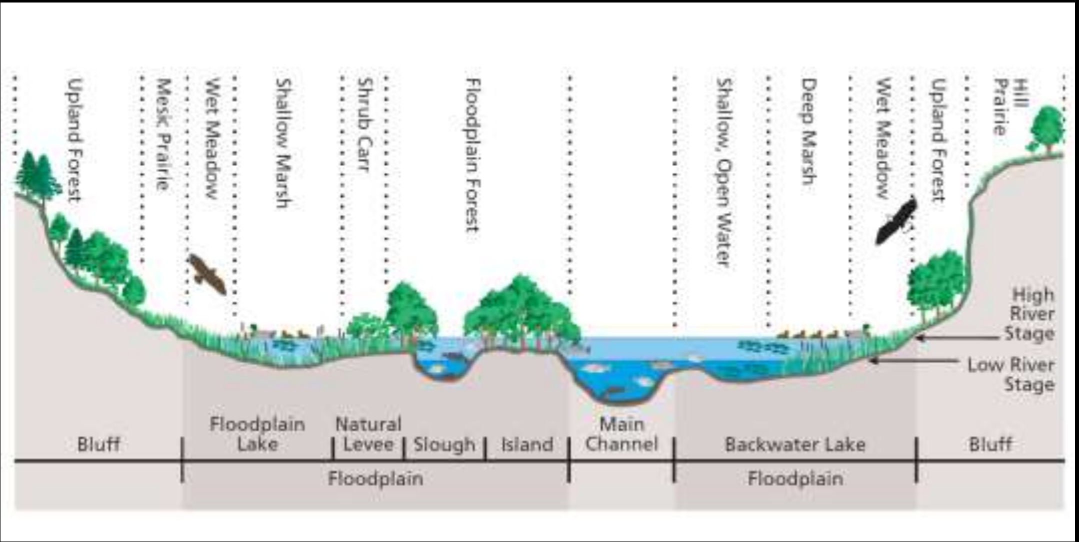


The Middle Course

- Physical Geography - Winding Sedately
- Erosion and Deposition
- Ecology - Life in the Meander Belt
- Highly Dynamic Landscape - Habitat Diversity

Course Stage	Upper Course Youth Stage	Middle Course Mature Stage	Lower Course Old Age Stage
Slope			

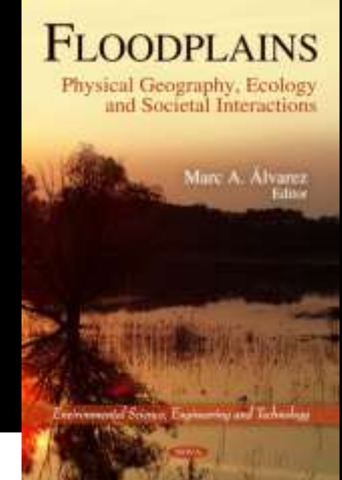


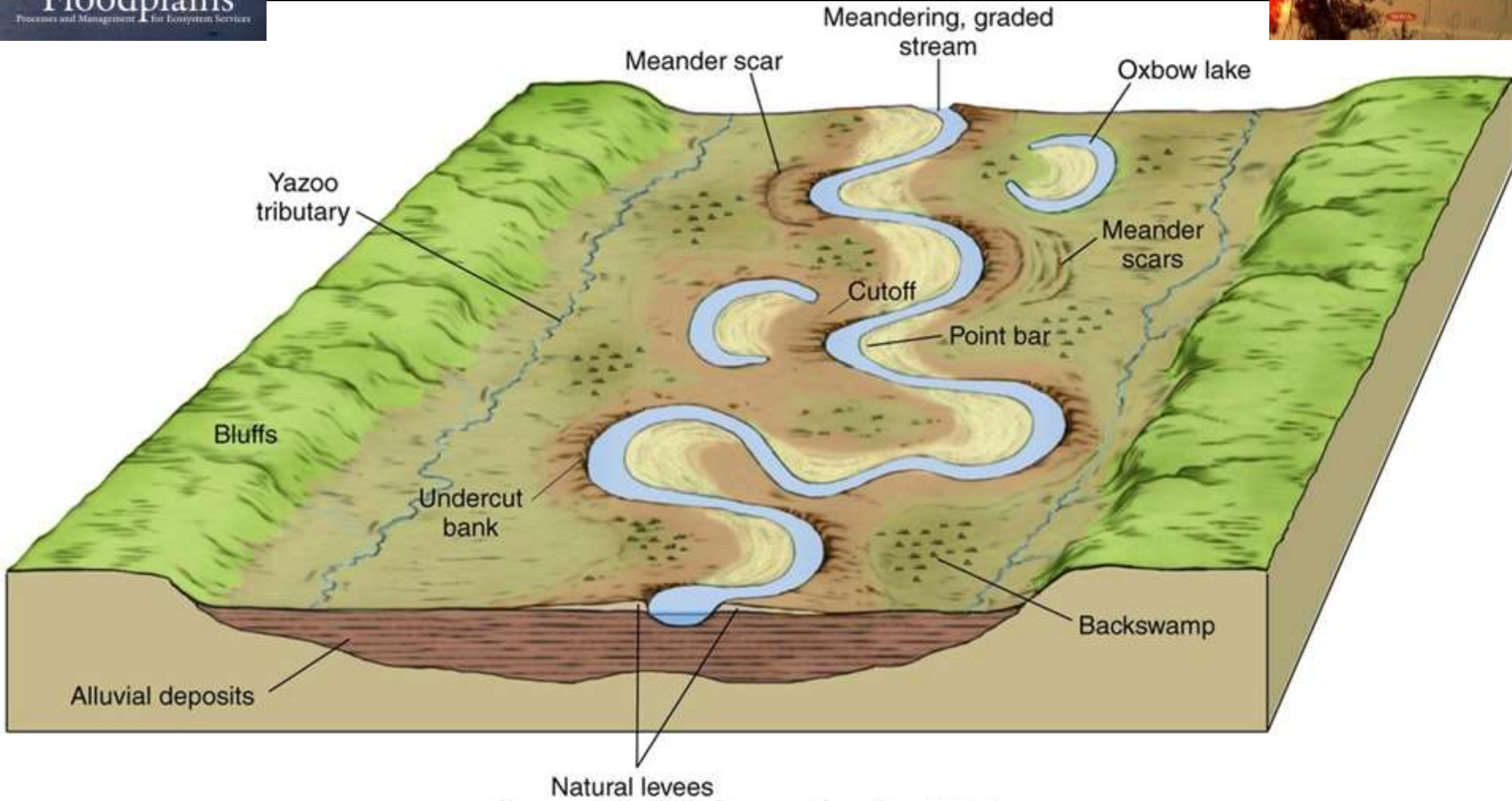


Fluvial Geomorphology

Erosion and Deposition

Floods shape the bottomland

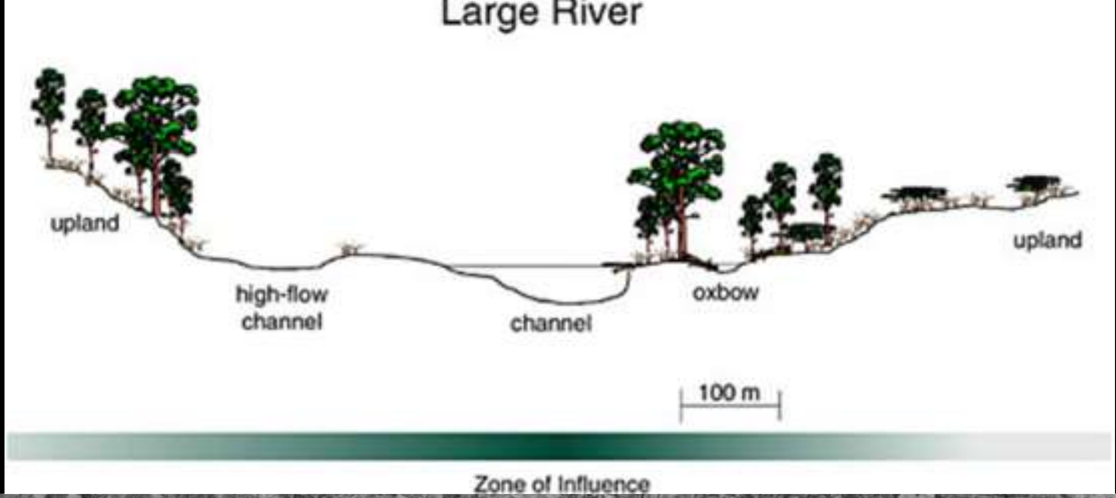


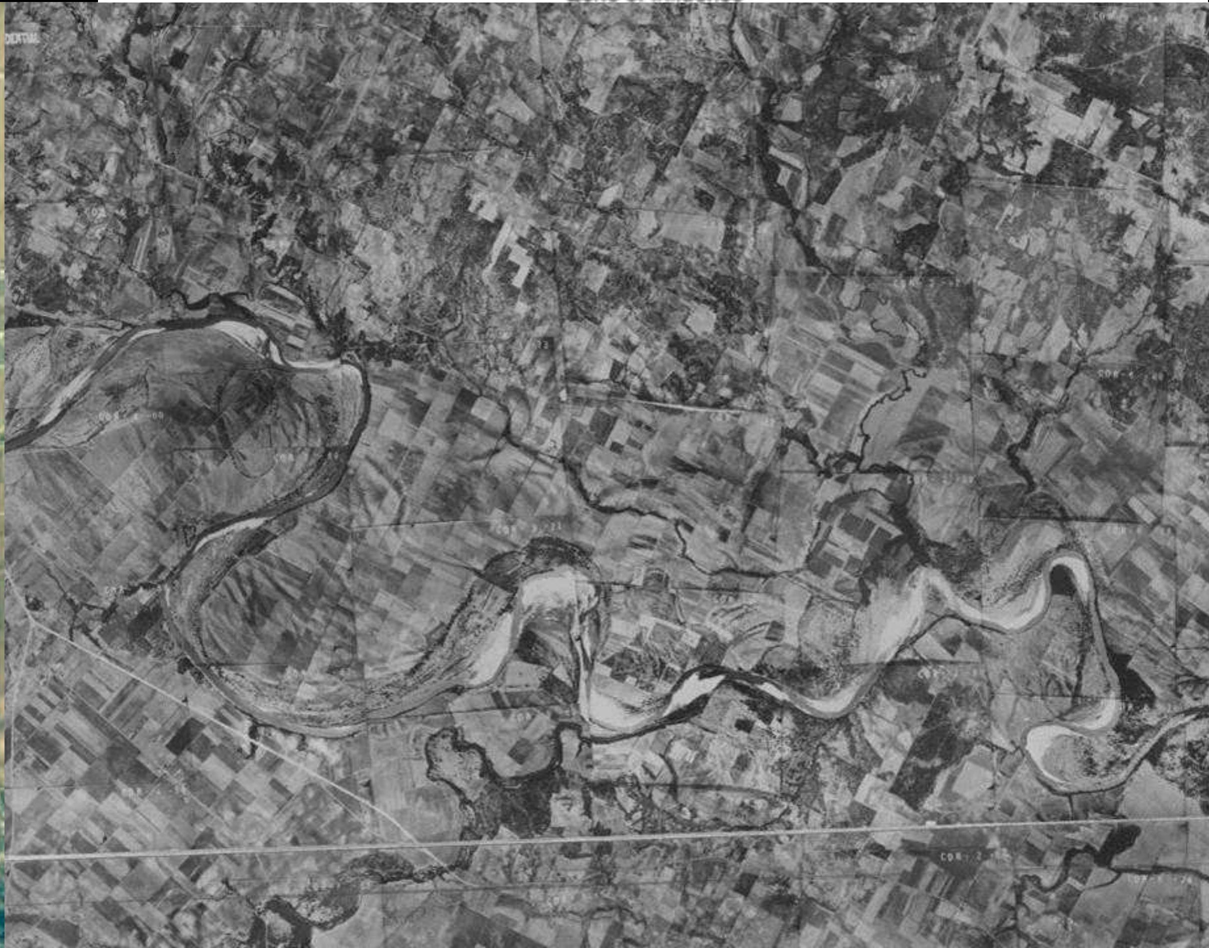


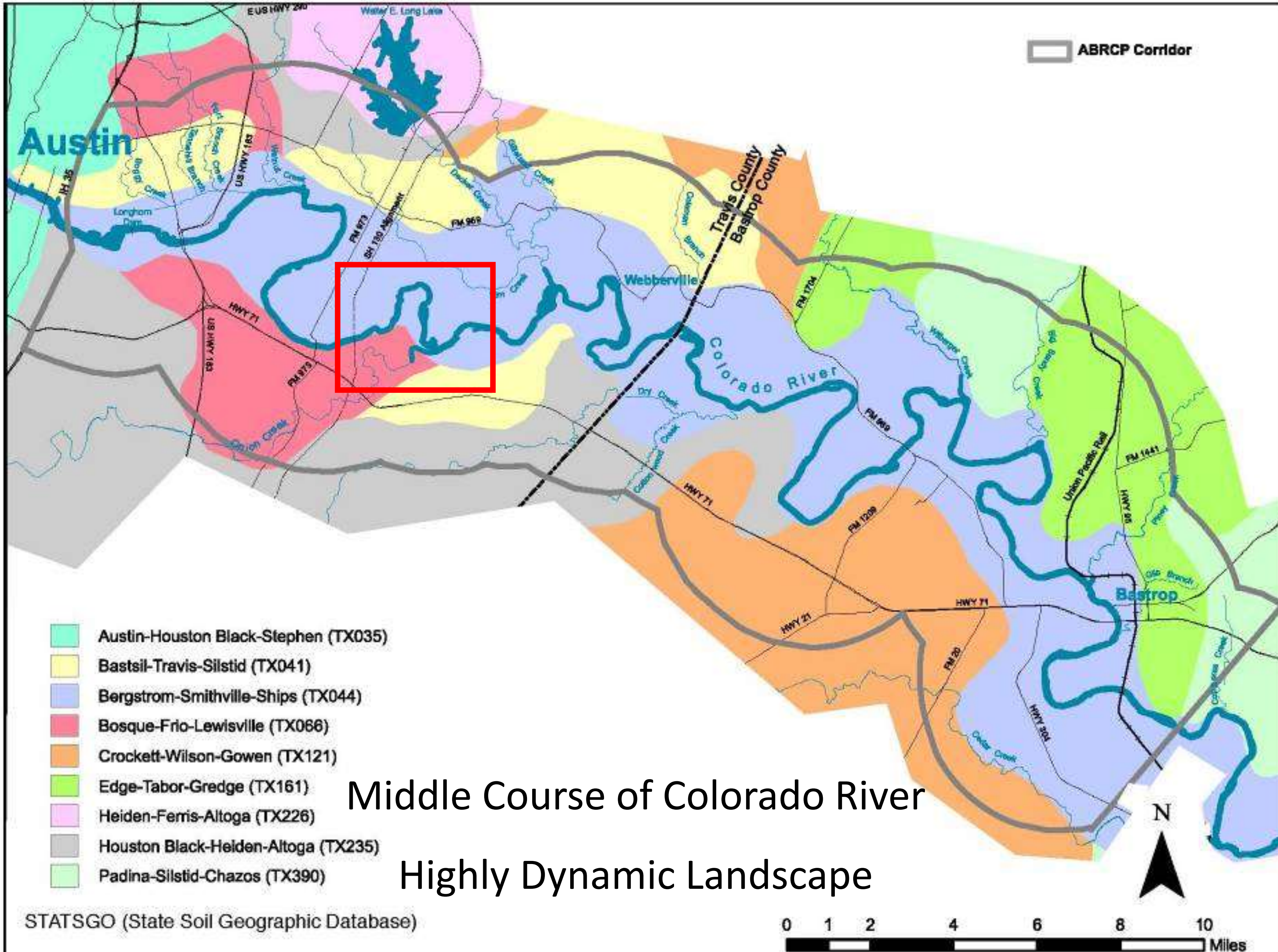
Flood History Written on Floodplain

High-flow Channels

Flood Scars







Middle Course of Colorado River

Highly Dynamic Landscape


2003


Old Mining Pit
2003


2006


80 feet
130 feet
Breach
Mining Pit
2006

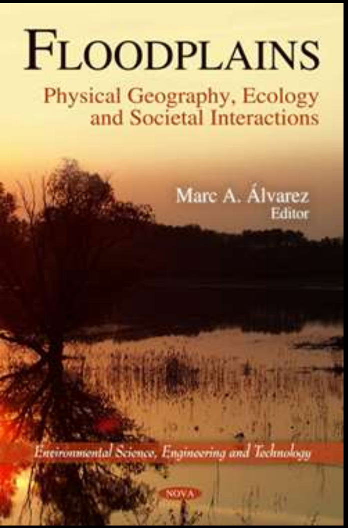
The Middle Course
Highly Dynamic Landscape

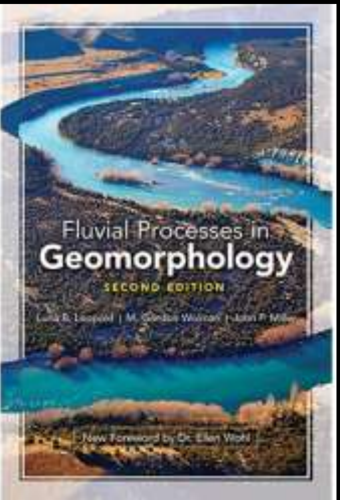
2018

The Lower Course – Old Age

A somewhat aimless course toward final extinction

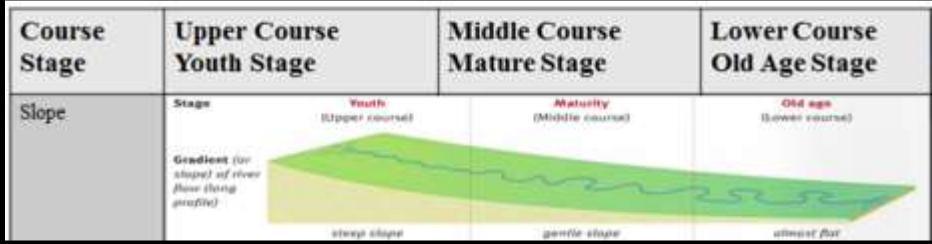
Wandering, Carrying, and Depositing





Colorado River, Texas

The Lower Course
Sediment Load and Organic Matter

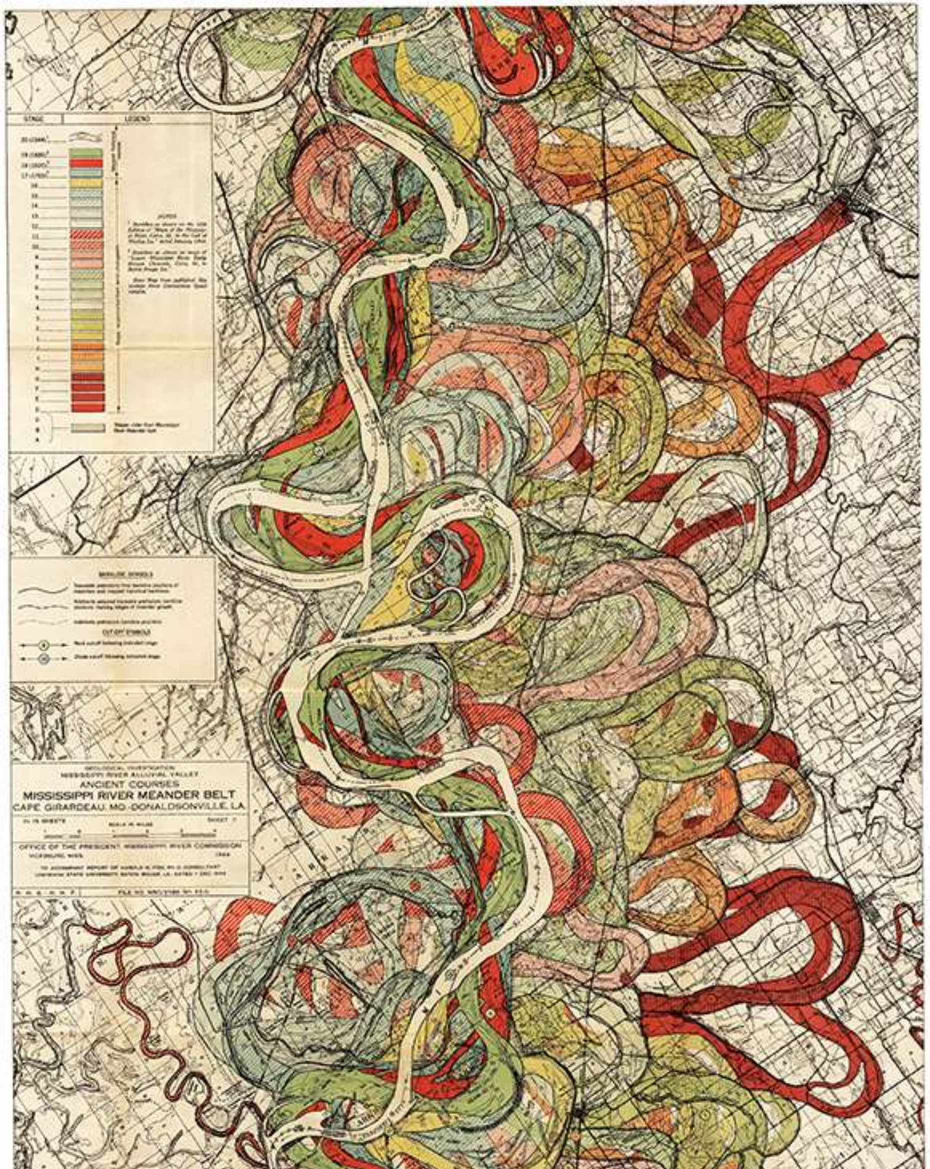


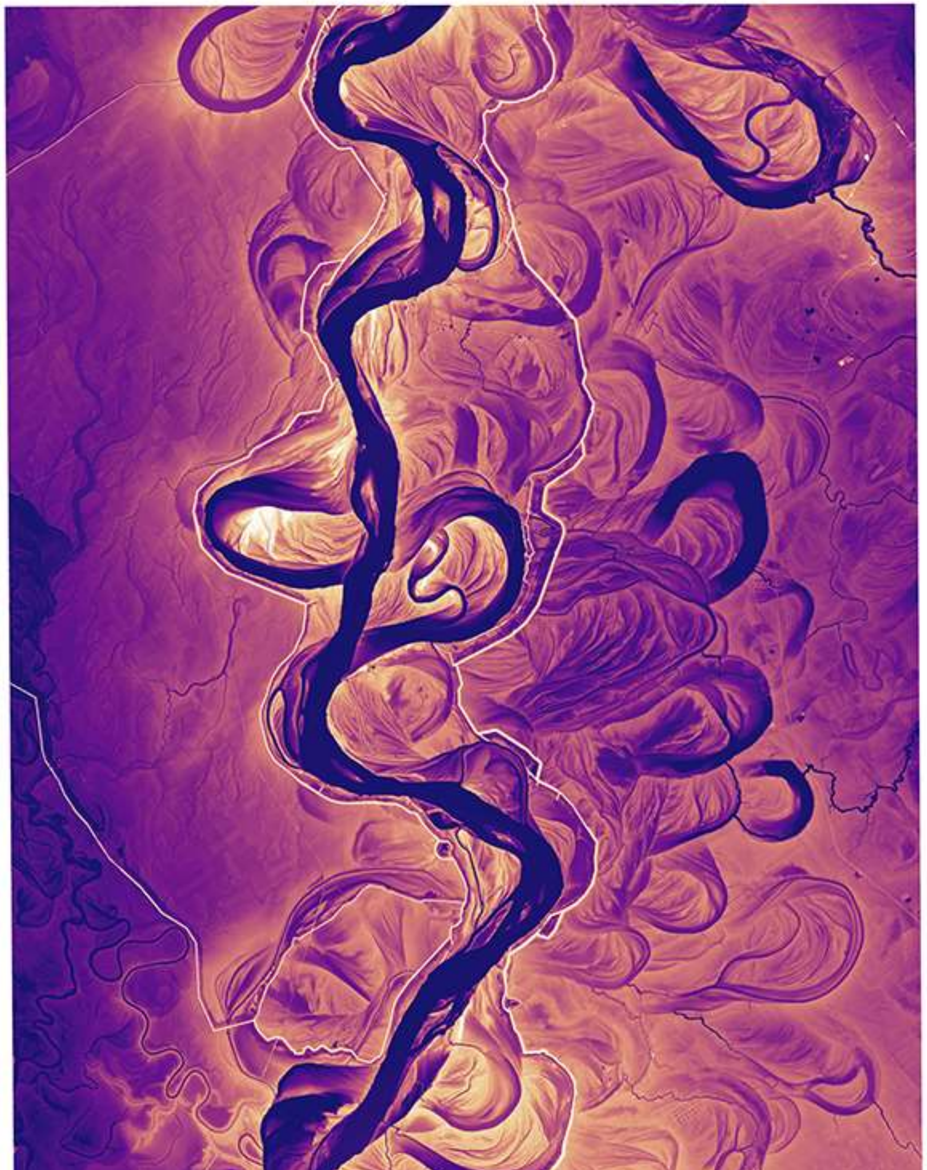
Course Stage	Upper Course Youth Stage	Middle Course Mature Stage	Lower Course Old Age Stage
Slope			

- Very large rivers are usually <u>low gradient and very wide</u>, resulting in <u>negligible influence of riparian canopy</u> in terms of shading and leaf-litter input.
- Water currents keep <u>fine solids in suspension, reducing light penetration</u> to the benthos.
- <u>Organic matter in suspension is by far the largest food base</u> in the lower course.

Highly Dynamic Landscape - Habitat Diversity

Larger alluvial rivers in their natural state are <u>diverse habitats</u> with side channels, sand and gravel bars, and islands that are formed and reformed on a regular basis.

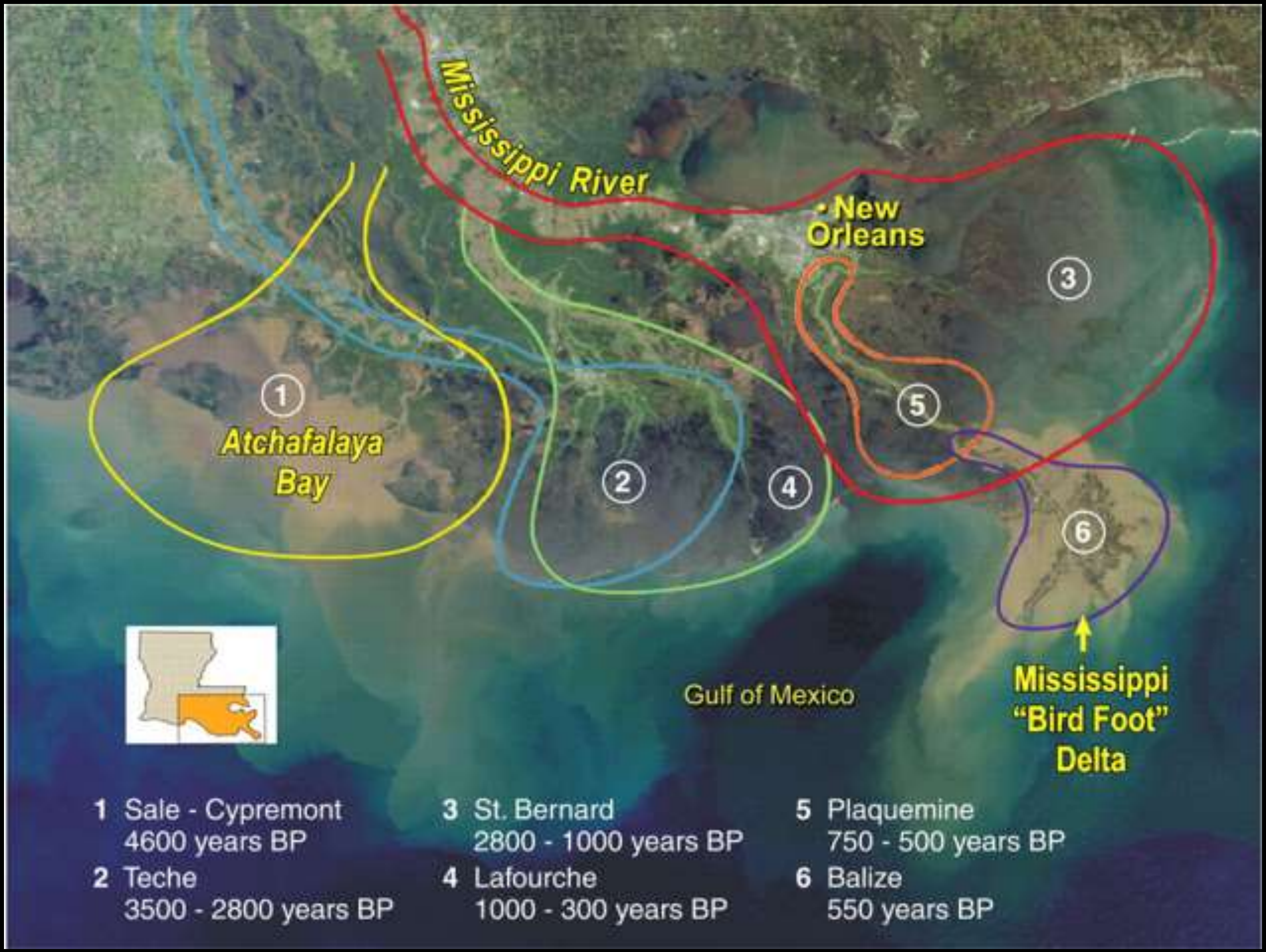




Avulsion

Rapid abandonment of a river channel and the formation of a new channel

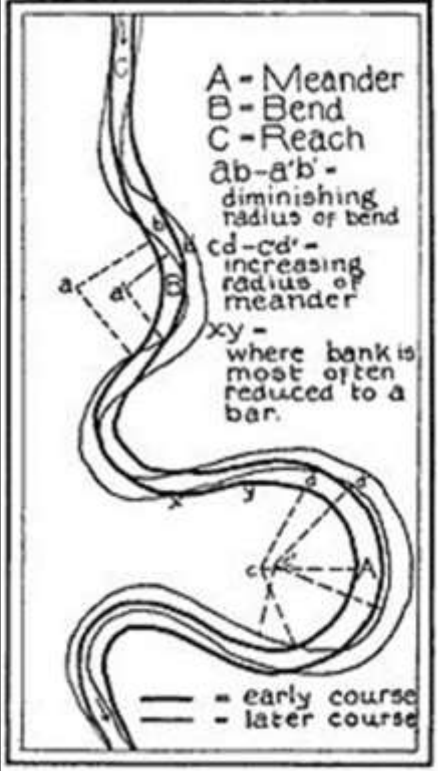
This process of avulsion in deltaic settings is also known as <u>delta switching</u>. When this avulsion occurs, the new channel carries sediment out to the ocean, building a new deltaic lobe.

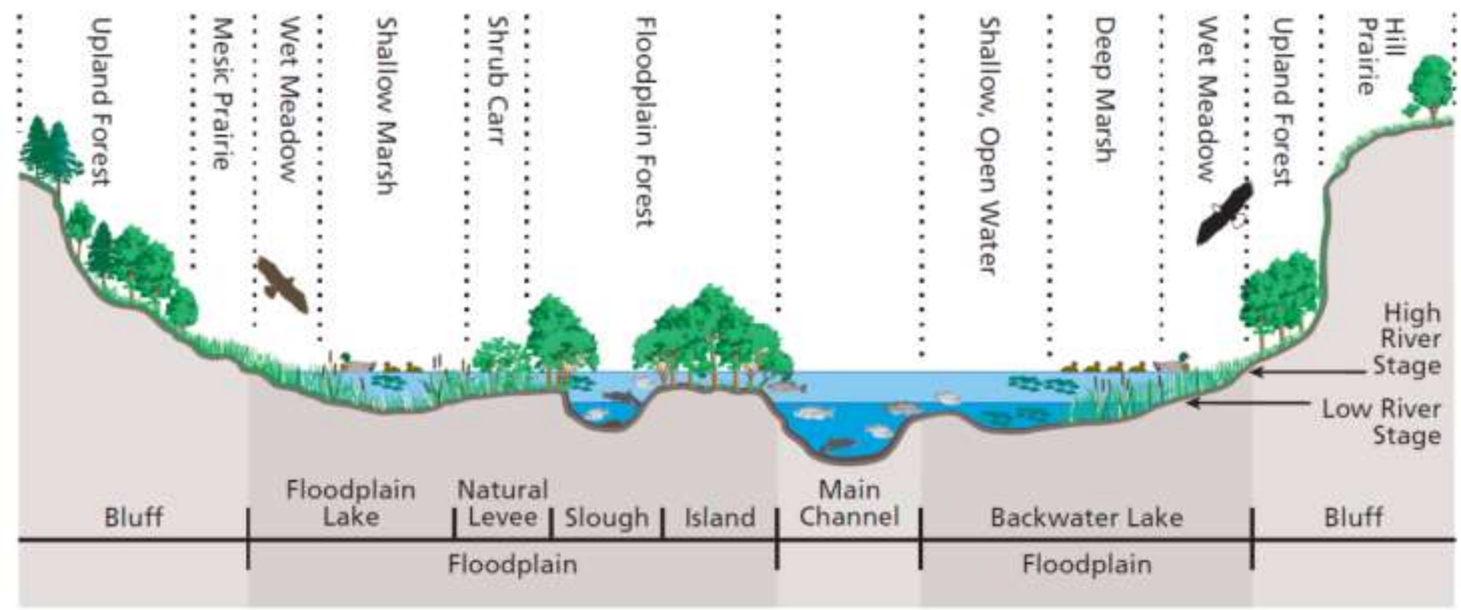


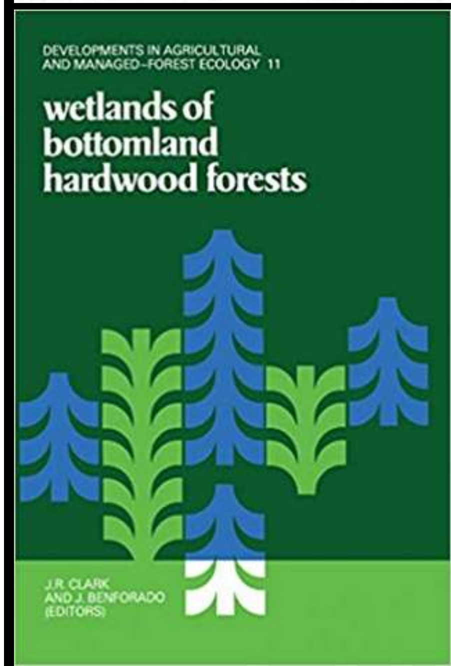
Location of Mississippi River channels discharging water into the Gulf of Mexico over the past 5000 years. Notice the location changes from time to time, keeping all areas of the delta supplied with sediments that balance the natural sinking of the delta. Today, two-thirds of the flow are through the Bird Foot Delta (6) and one third through the Atchafalaya (1)

Bottomland Habitat
Middle and Lower Course

- Diverse and Dynamic
- The Meander Belt

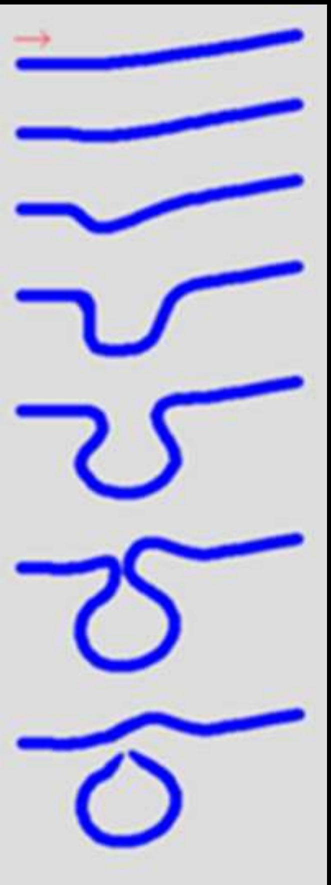


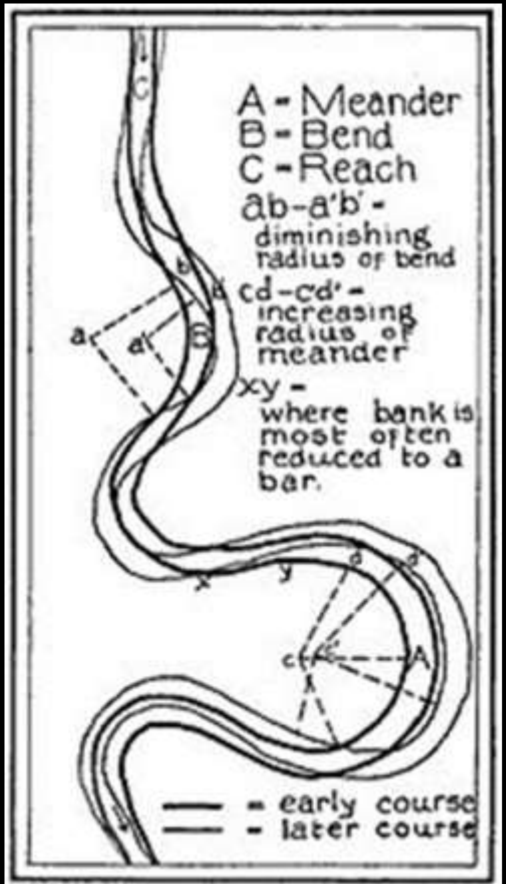


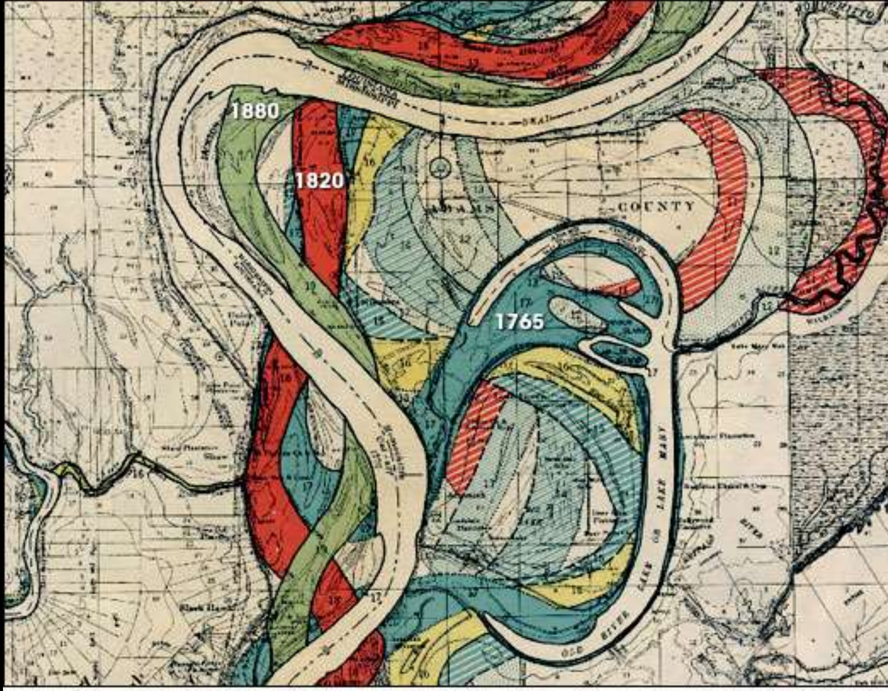


The Life of a Meander - Habitat

- When deposition seals off the cut-off meander from the river channel, an oxbow lake is formed. It may silt up and eventually dry up.
- This leaves meander scars on the floodplain that simply mark the old channel.







Map, 1944

Mississippi River

Satellite Image September 22 1999

Oxbow Lake


Meandering, graded stream
Meander scar
Oxbow lake
Yazoo tributary
Meander scars
Cut
Point bar
Bluffs
Backswamp
Alluvial deposits
Natural levees
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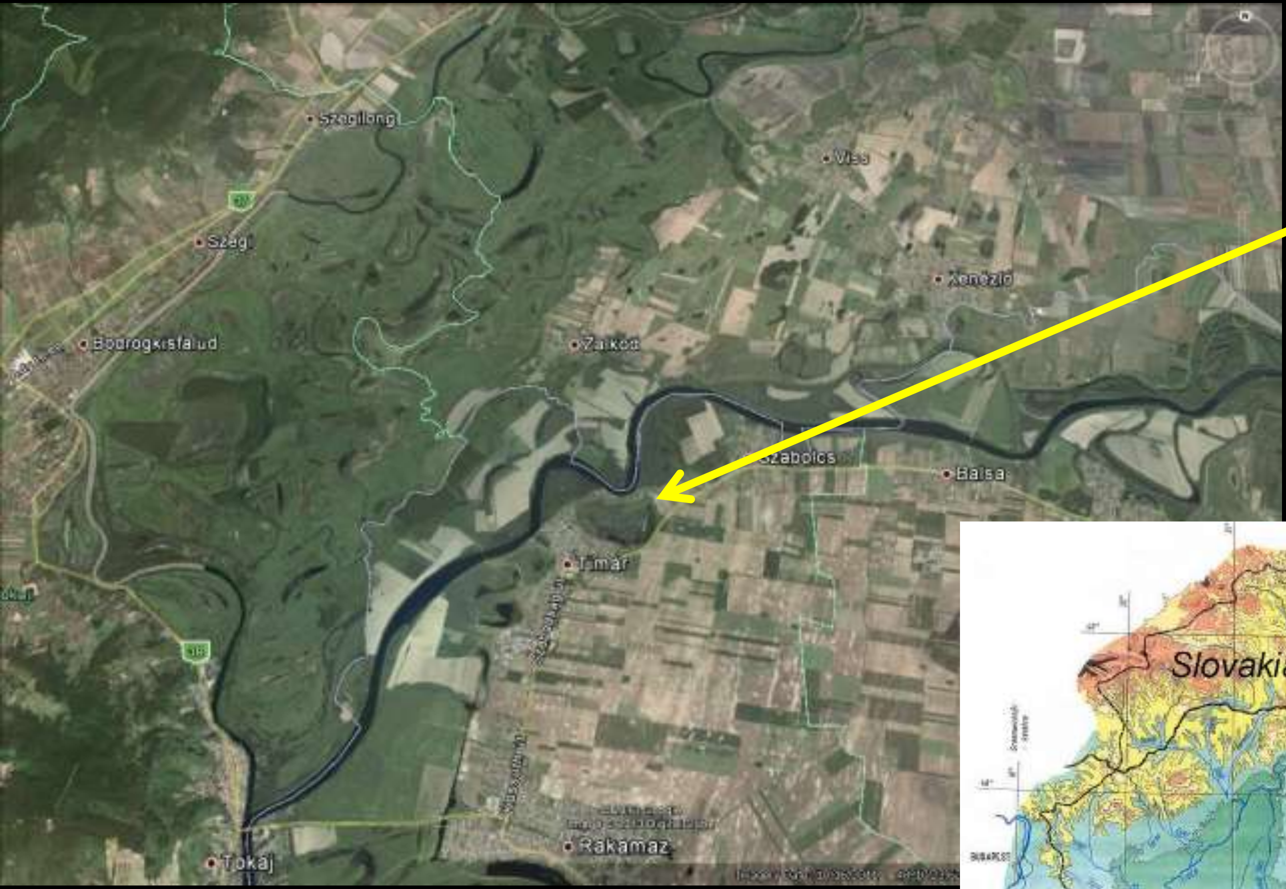
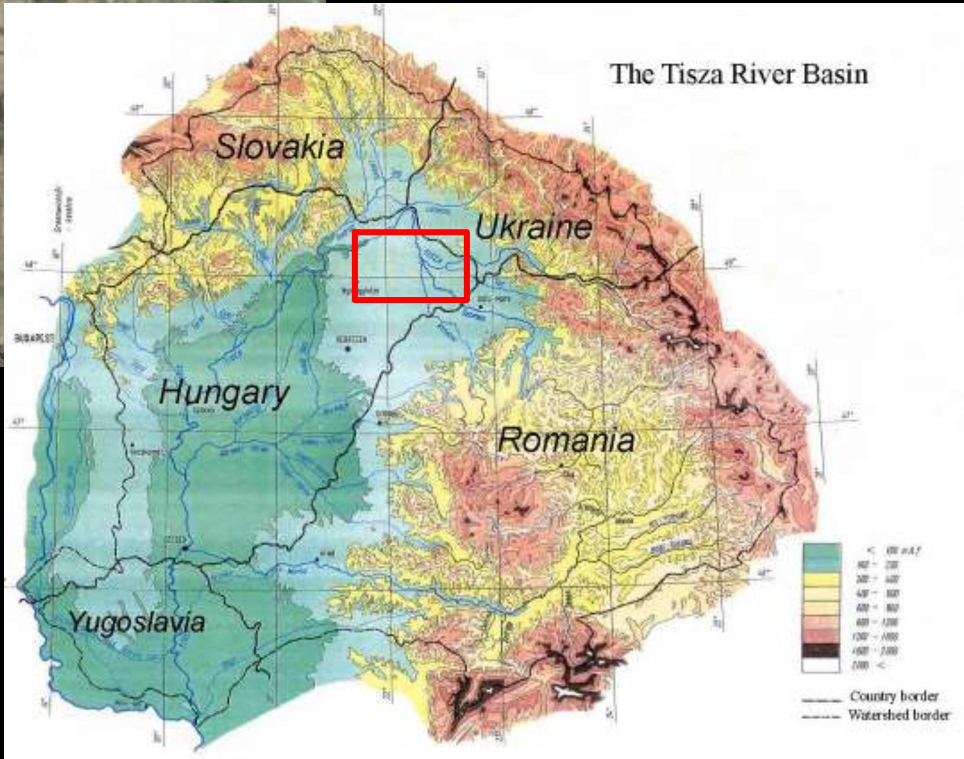
Google


wetlands of
bottomland
hardwood forests

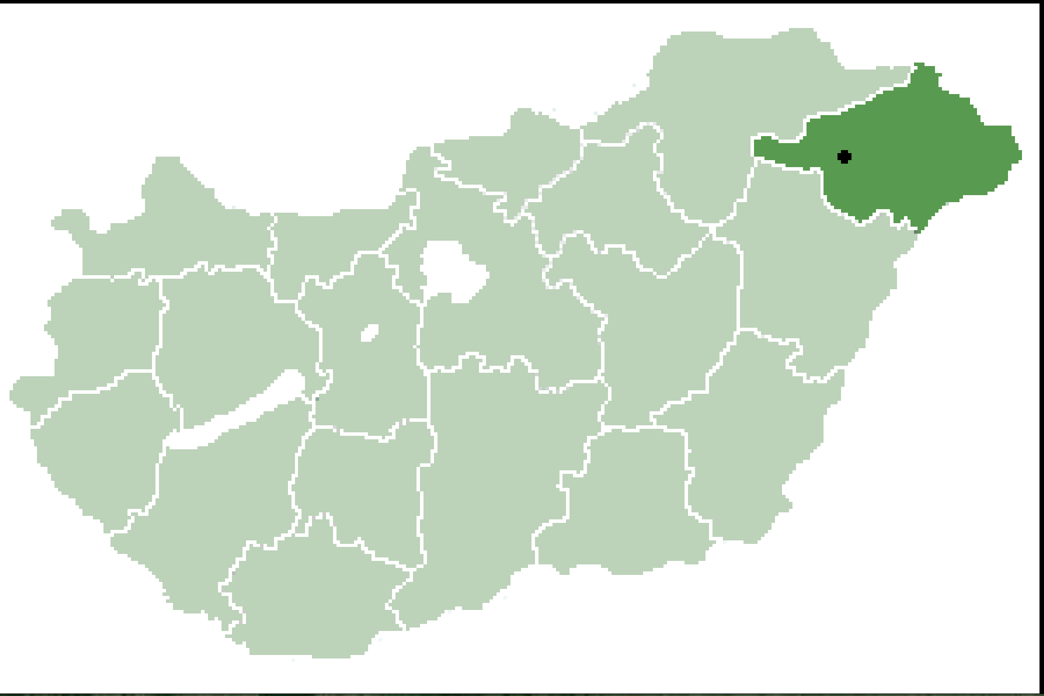
Oxbow Lakes and Meander Scars – The Bodrogköz
The Tisza and Bodrog Rivers – Northeastern Hungary

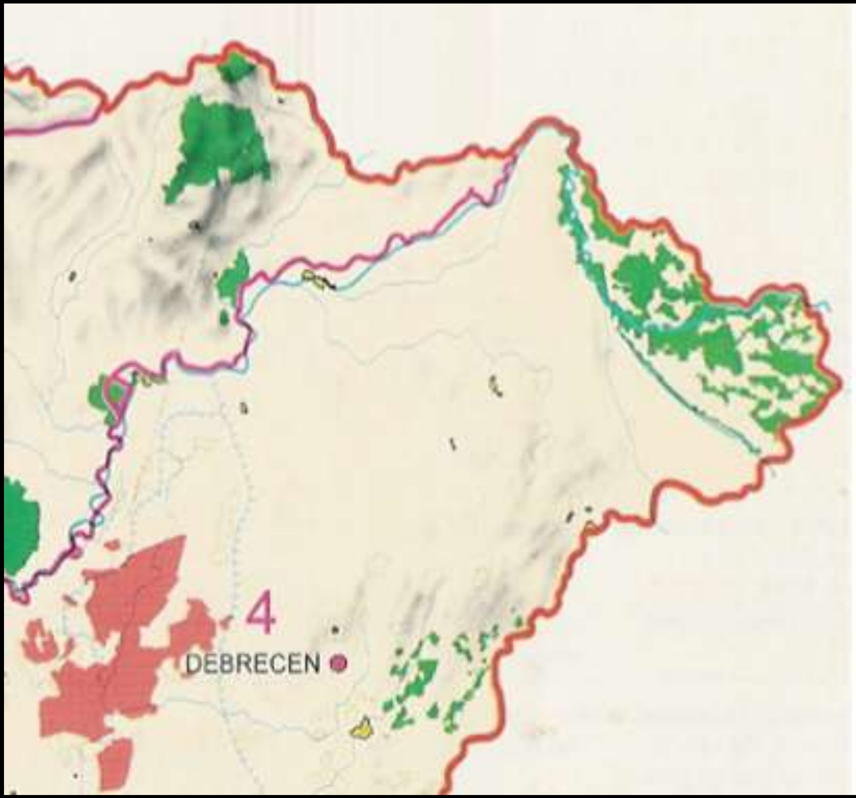




The Bodrogköz lowland region lies between the Bodrog and Tisza rivers. The southern part belongs to Hungary and the upper Bodrogköz is on the other side of the border in Slovakia.

The Upper Tisza Region - Szabolcs-Szatmár-Bereg County

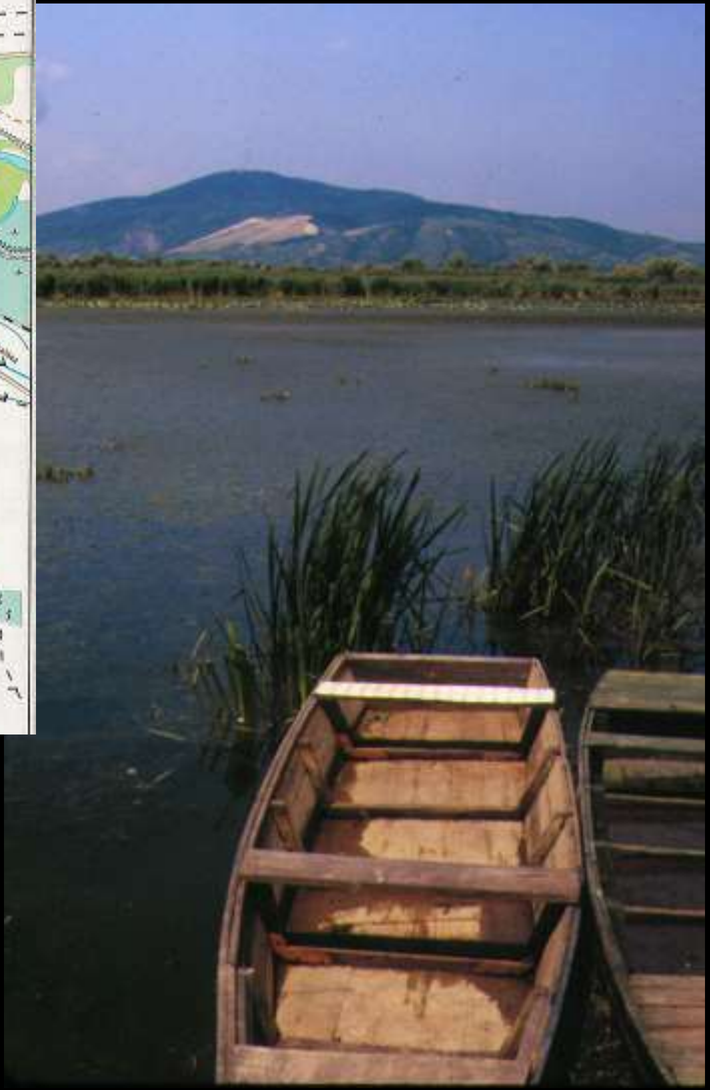




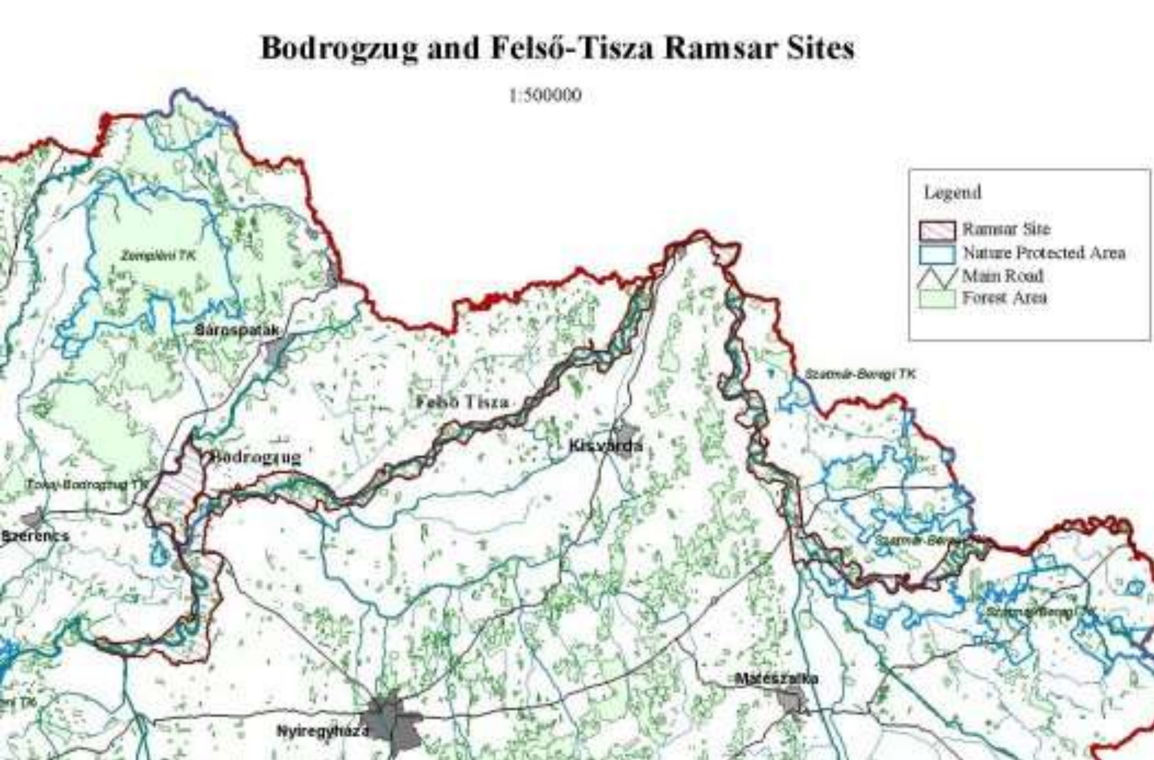
Green – Nature “Protected” Areas

Red – Hortobagy National Park

1990



Tokaj and the Bodrogkoz



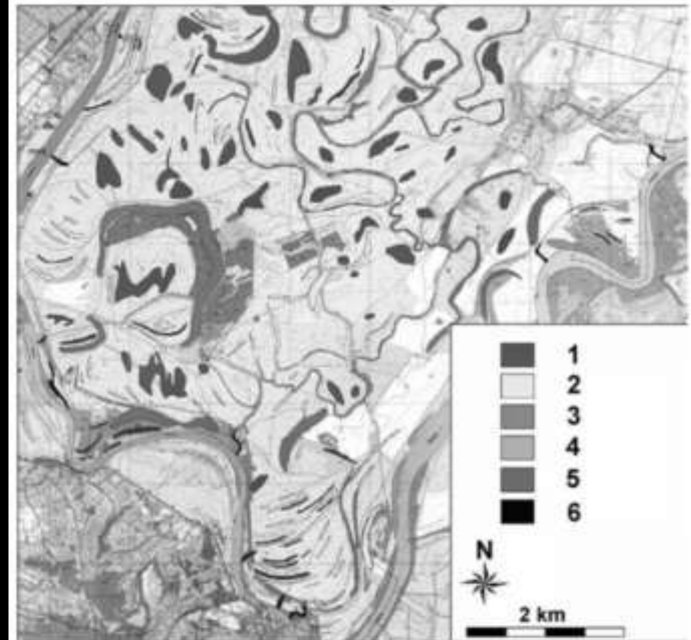
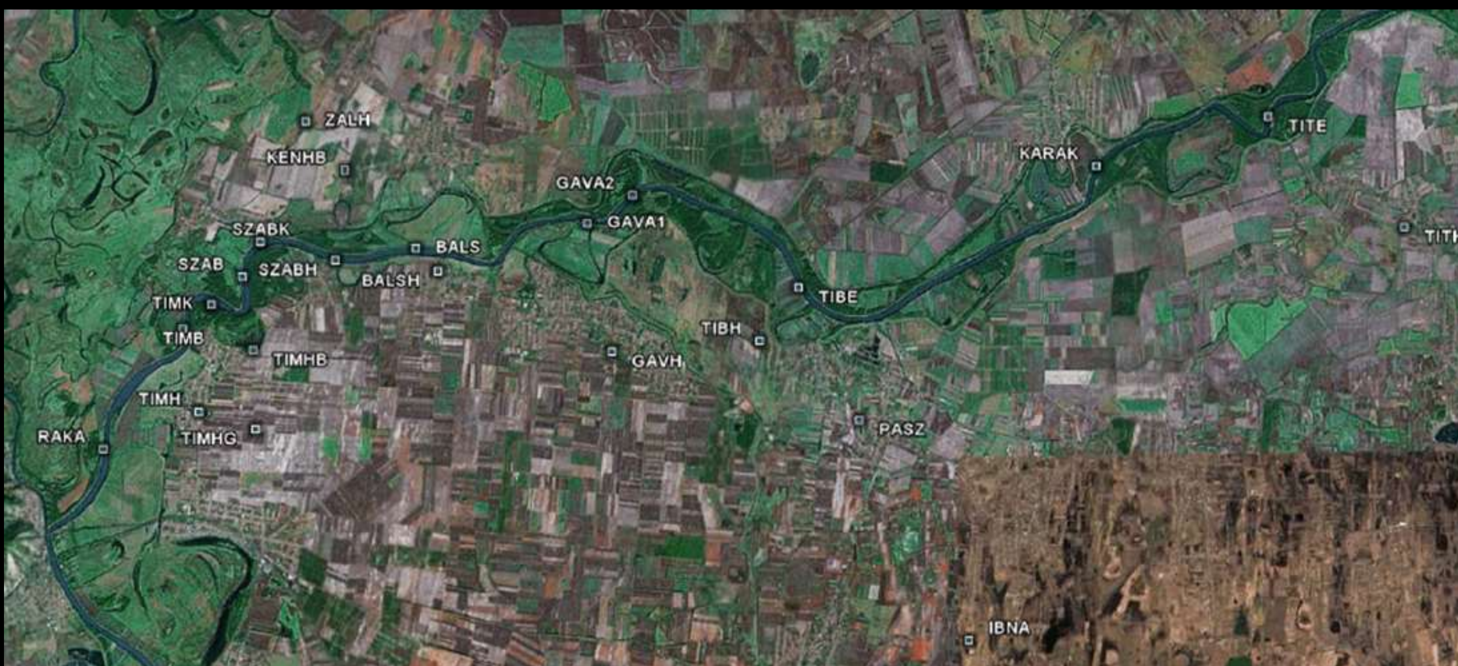
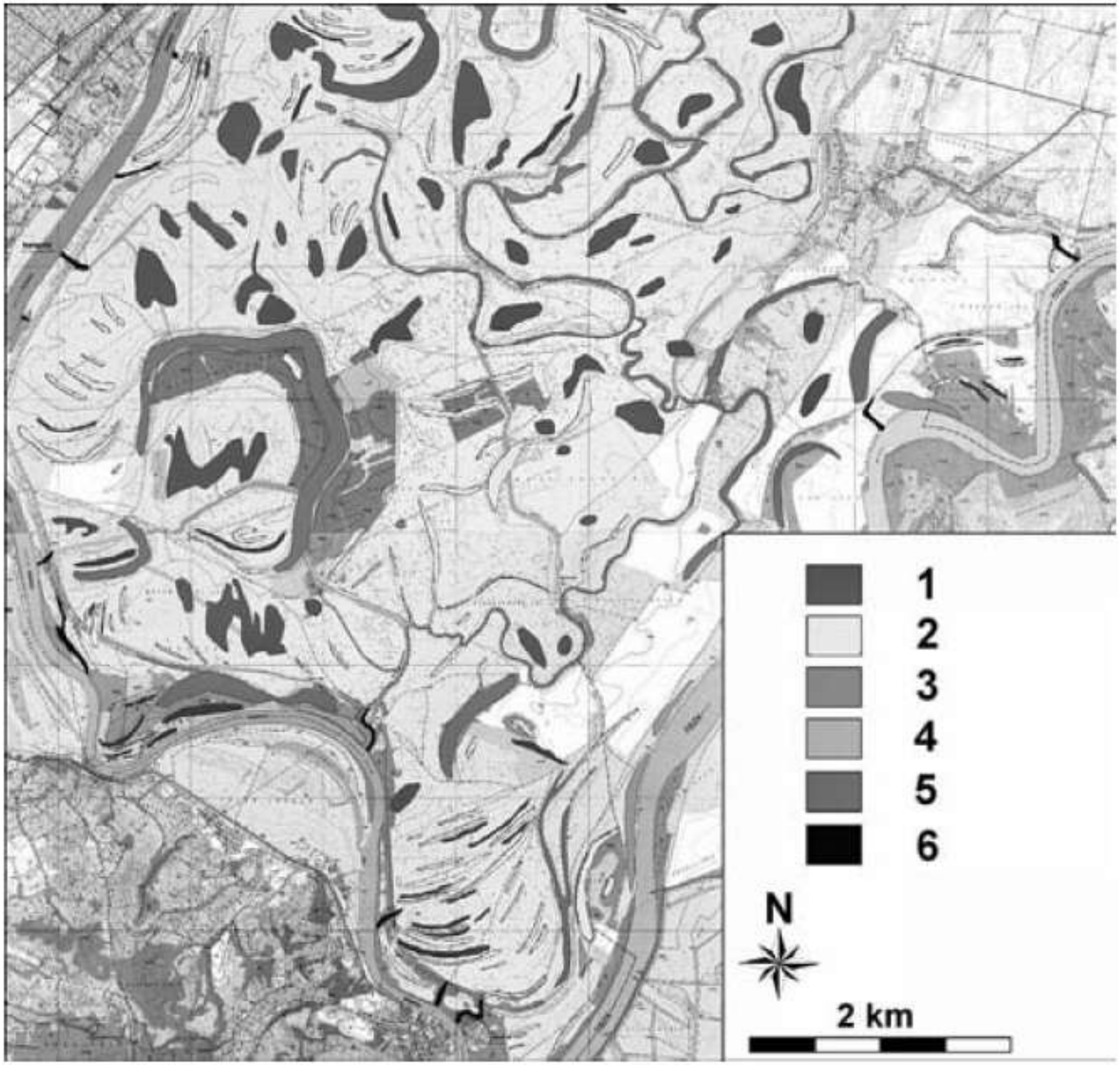


FIG. 2 - Landforms of the SW Bodrogköz (In: Szabó & *alii*, 2004). 1: fluvial ridge, 2: swale, 3: abandoned cut-offs, 4: present natural levee, 5: backswamps, 6: (remnants of) one-time flood-plain ditches.



Upper Tisza River in northeastern Hungary.

Now a cross-border UN Ramsar Wetland of International Importance



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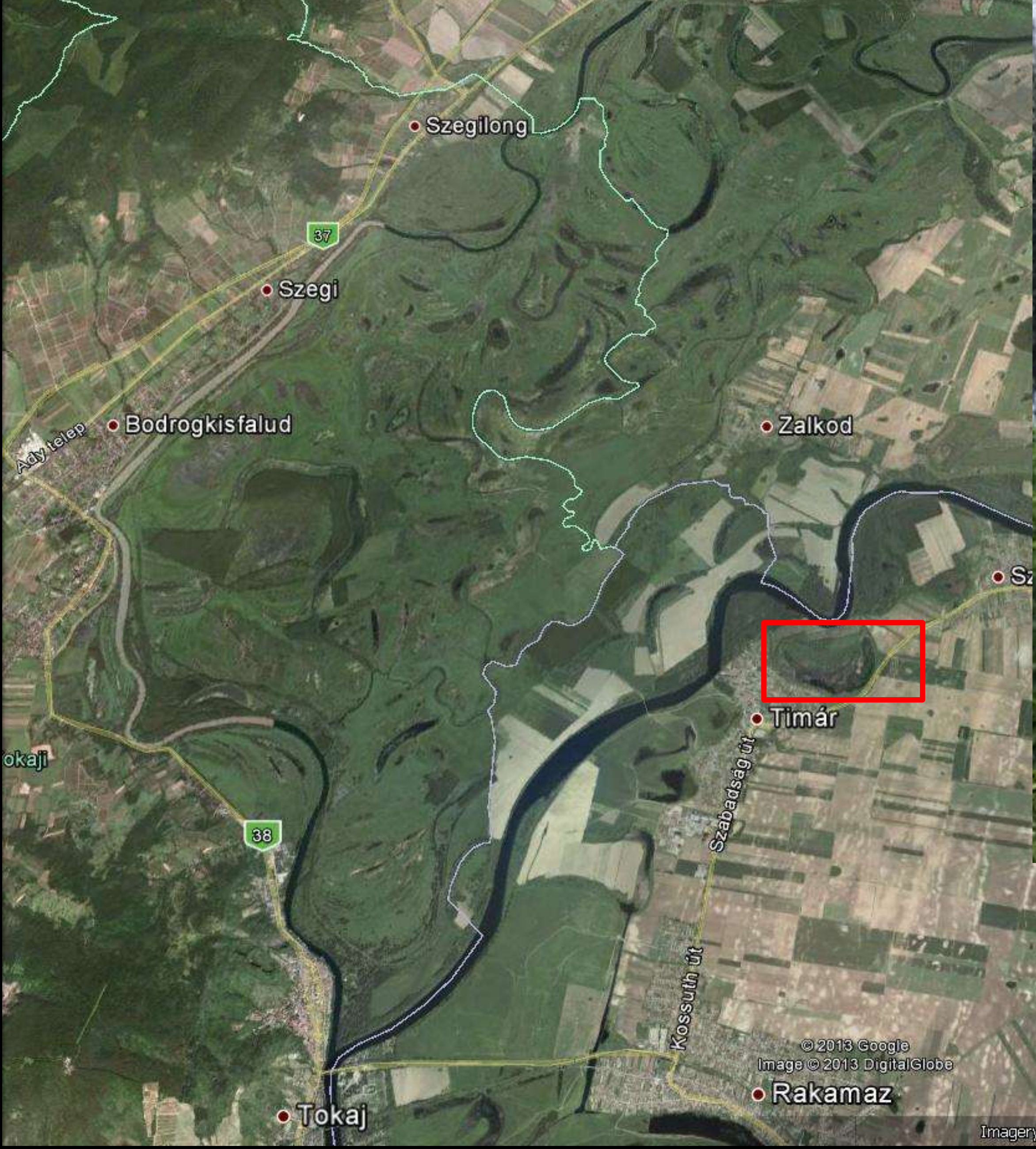


Upper Tisza Foundation

Felső-Tisza Alapítvány

Oxbow lake managed by Upper Tisza Foundation

Upper Tisza Foundation
Felső-Tisza Alapítvány

Tisza River Ecological Research Center

Established 2002

Szabolcs, Hungary

Magyar Madártani és Természetvédelmi Egyesület

Upper Tisza Foundation

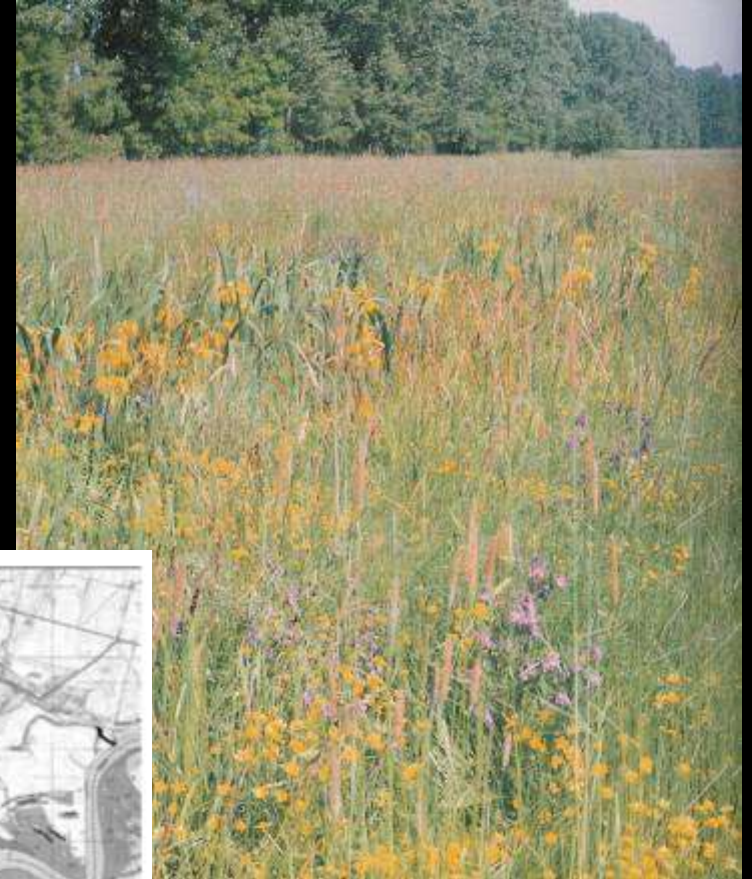
Felső-Tisza Alapítvány

Upper Tisza Foundation
Felső-Tisza Alapítvány

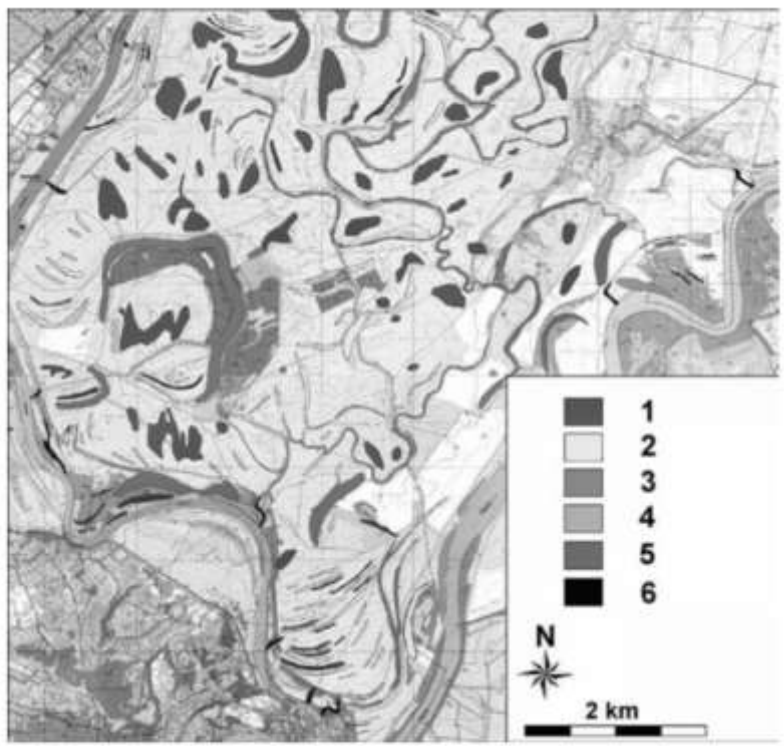

Upper Tisza Foundation
Felső-Tisza Alapítvány

More Bottomland Habitats

Forest wetland



Wet meadow



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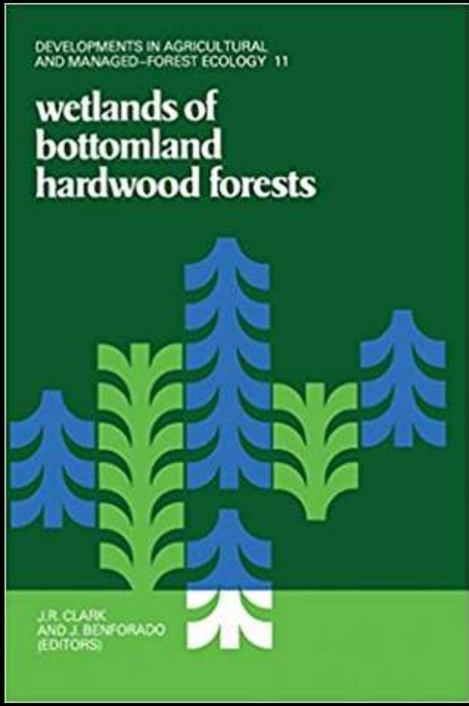
Bottomland Habitat

Marsh or Swamp?

- Marshes are nutrient-rich wetlands that support a variety of reeds and grasses
- Swamps are defined by their ability to support woody plants and trees.

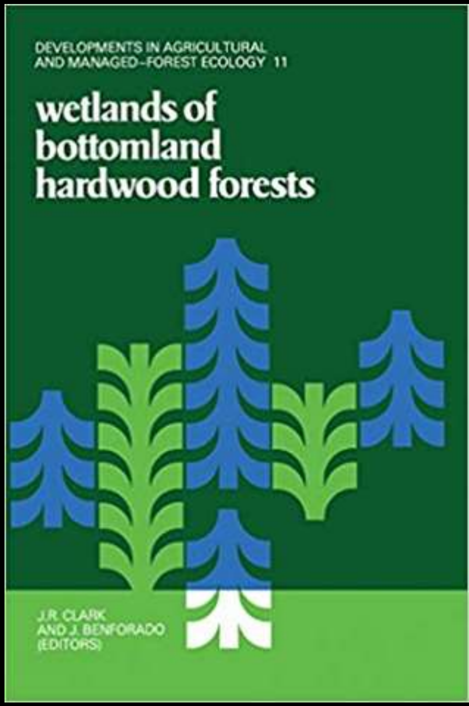


Bottomland Habitat

Sloughs and Backwaters

Slough usually rhymes with shoe in the U.S. except in New England, where it usually rhymes with now, the preferred British pronunciation.

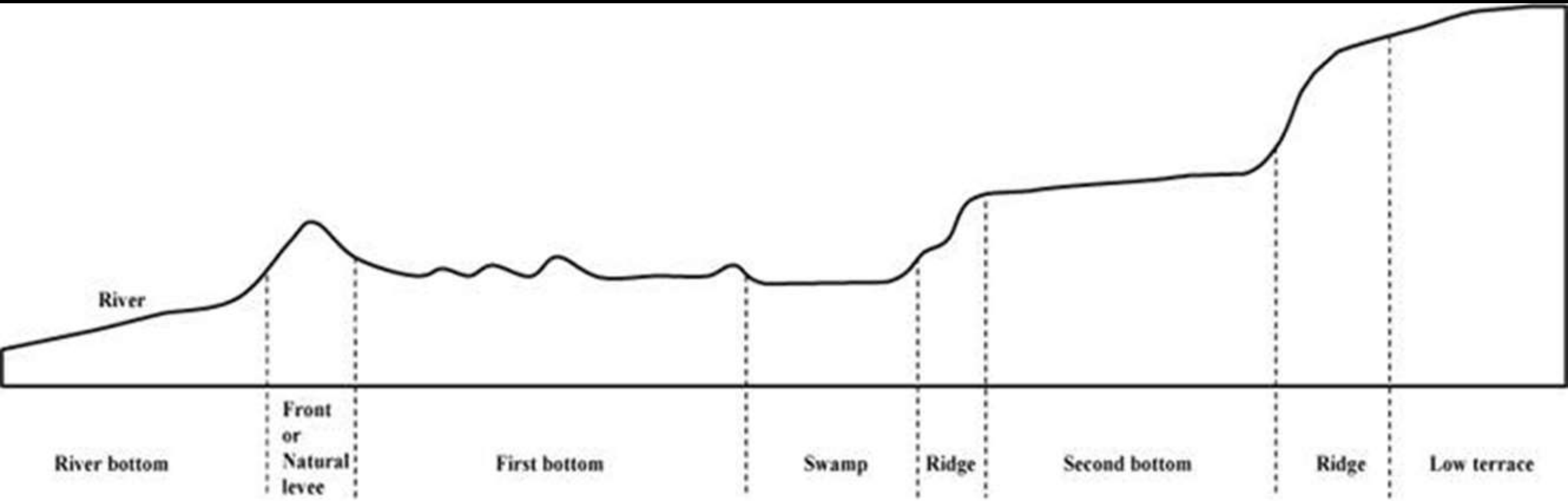
Slough may mean a place of deep mud or mire, a swamp, a river inlet or backwater, or a creek in a marsh or tide flat.

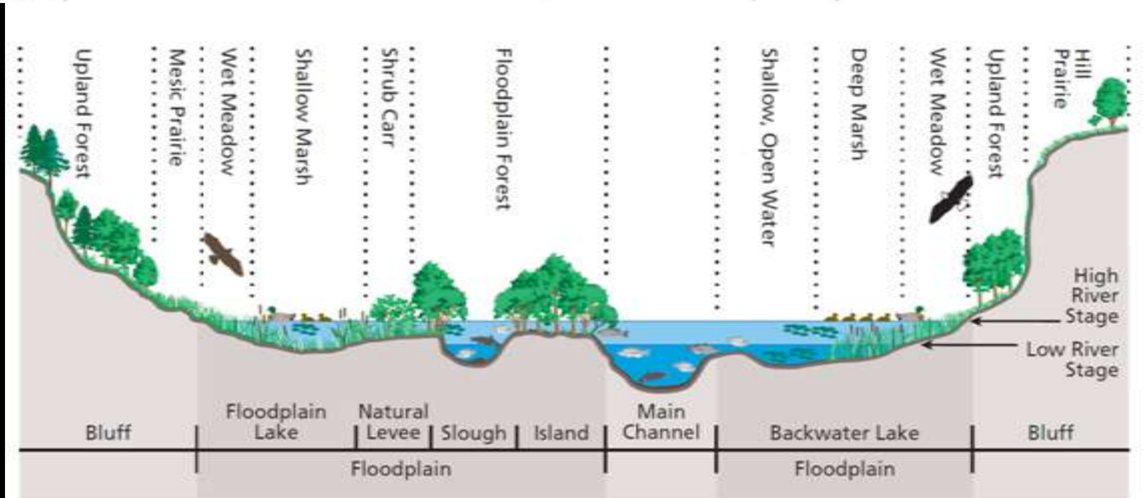


Bottomland Ecology

Elevation Changes Plant Communities

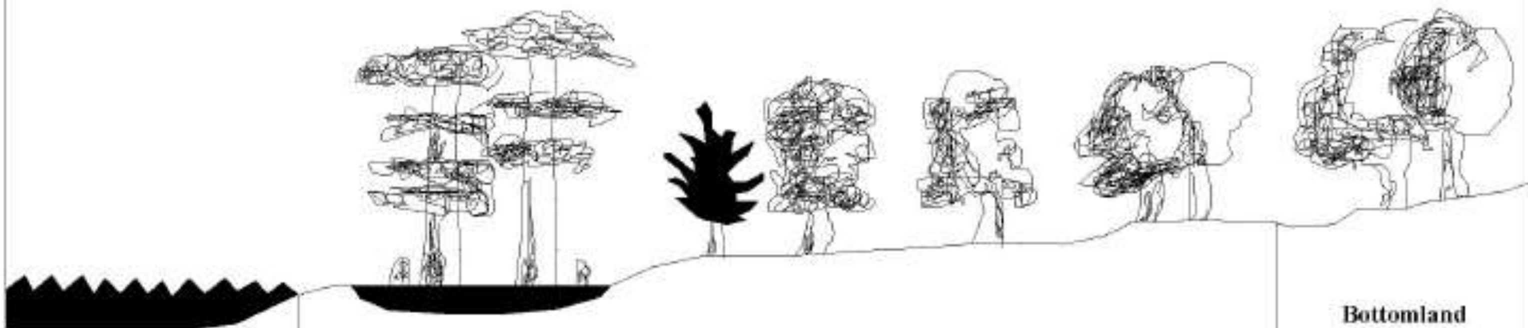
Habitat Richness = High Biodiversity





Life on the Floodplain

Bottomland Vegetation



	Aquatic ecosystem	Bottomland hardwood ecosystem				Bottomland upland transition
Zone	I	II	III	IV	V	VI
Name	Open water	Swamp	Lower hardwood wetlands	Medium hardwood wetlands	Higher hardwood wetlands	Transition to uplands
Water modifier	Continuously flooded	Intermittently flooded	Semipermanently flooded	Seasonally flooded	Temporarily flooded	Intermittently flooded
Flooding frequency, % of year	100	~100	51 - 100	51 - 100	11 - 51	1 - 10
Flooding duration, % of growing season	100	~100	> 25	12.5 - 25	2 - 12.5	< 2

Central Texas Bottomland Vegetation

Central Texas Wetland Plants

About This Guide

Central Texas Wetland Plants is a collection of institutional knowledge and photos taken in and around the Austin area. It is not intended to be comprehensive, but rather to be used as a supplement to other resources when identifying plants in Central Texas. Special Thanks to wetland biologist emeritus Mike Lyday, whose 20 years of service, dedication and experience established the foundation for wetland protection in the City of Austin.

Wetland Indicator Categories

- **Obligate Wetland (OBL):** Occur almost always in wetlands (probability >99%)
- **Facultative Wetland (FACW):** Usually occur in wetlands (67%-99%)
- **Facultative (FAC):** Equally likely to occur in wetlands or nonwetlands (34%-66%)
- **Facultative Upland (FACU):** Occasionally found in wetlands (1%-33%)
- **Obligate Upland (UPL):** Occur almost always in nonwetlands in the specified region

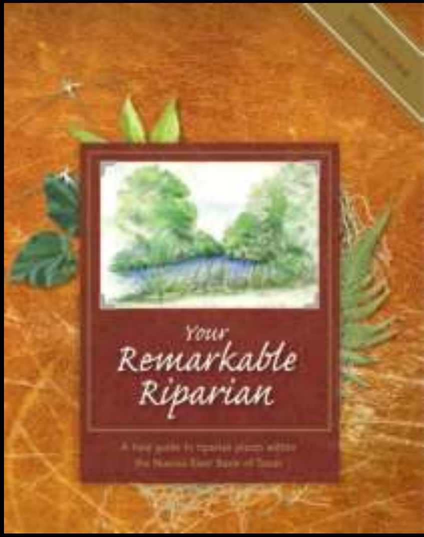
A positive (+) or negative (-) sign is used with the FAC category to indicate a regionally higher or lower frequency of being found in wetlands, respectively.

Photo credits: Mike Lyday, Bill Carr, Andrew Clamann, Morgan Grubbs, Emily Yeoman, and Scott Hiers

Field Guide

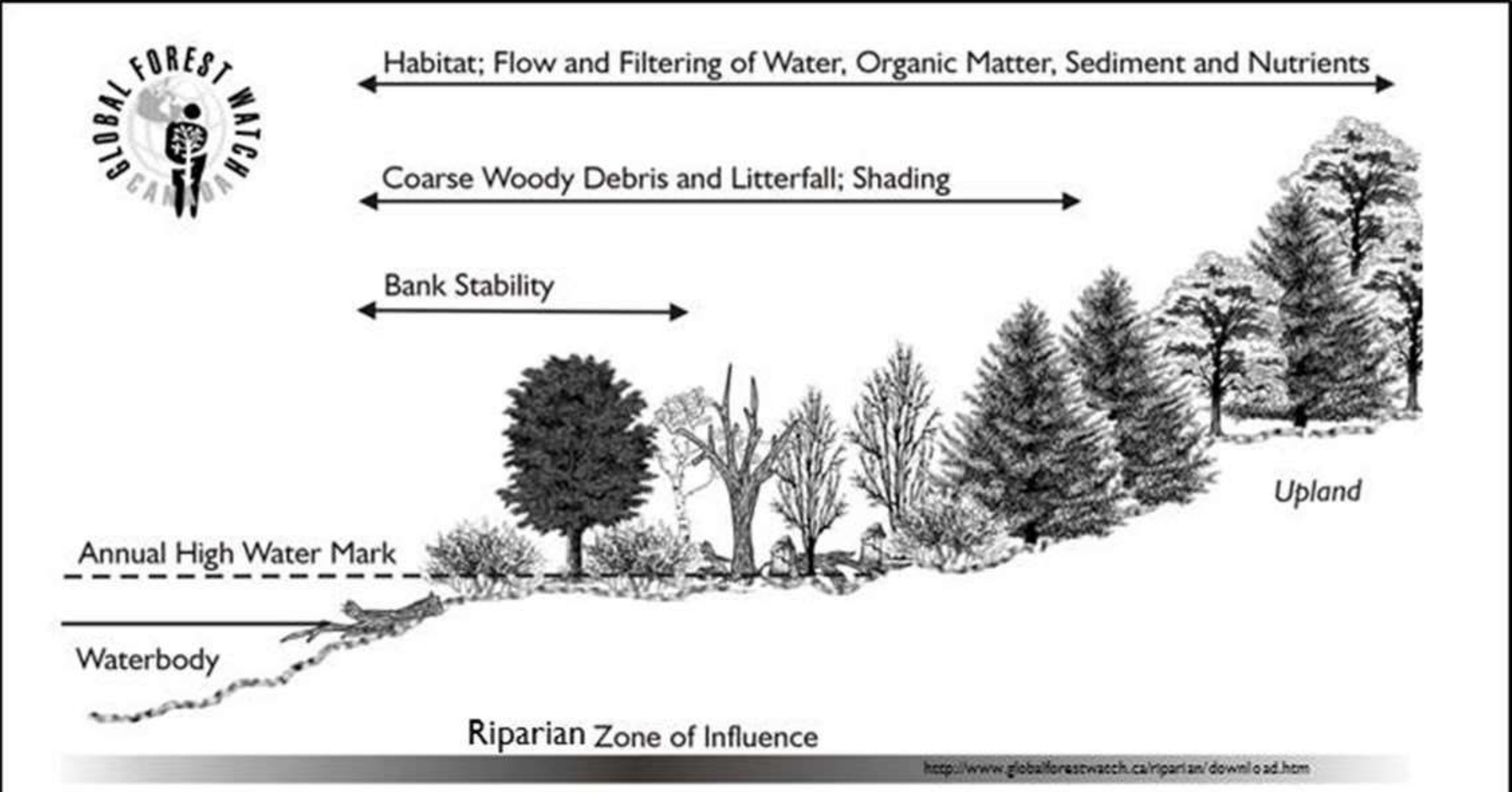
WATERSHED PROTECTION

TEXAS RIPARIAN ASSOCIATION



Bottomland and Riparian Vegetation

- Plant community structured by hydrology
- Hydric Soils
- Different plant species support riparian zone ecosystem function.

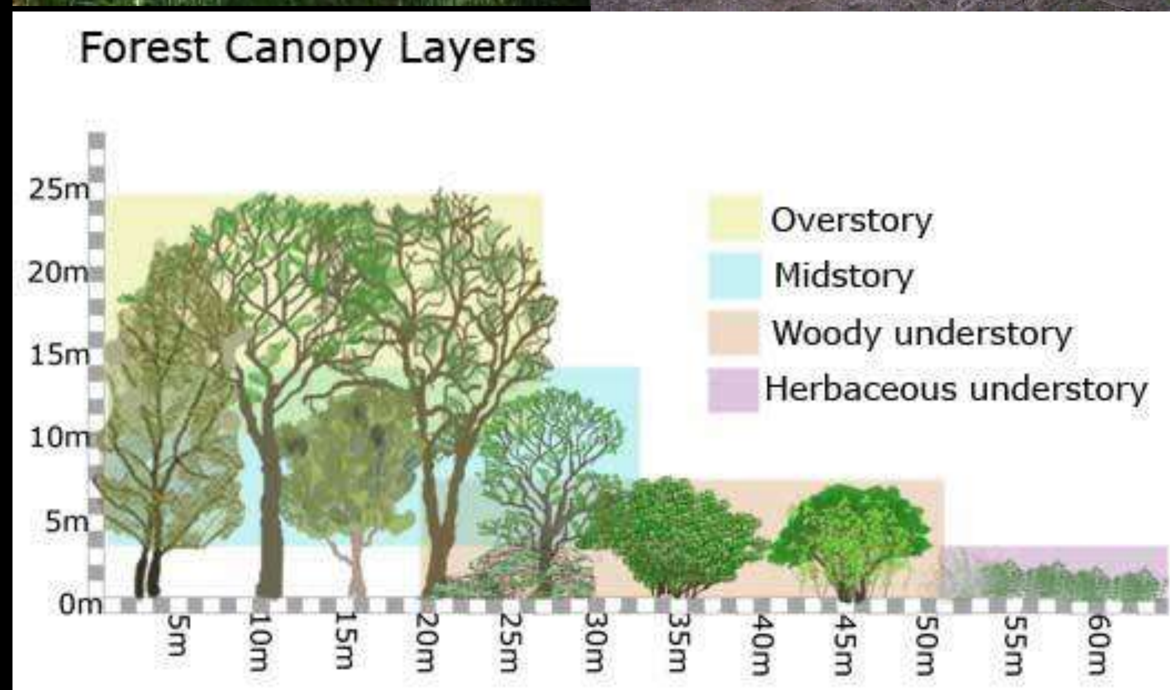


Floodplain Vegetation

Bottomland Forest and Open areas - “Bottomland prairies” (wet meadows)

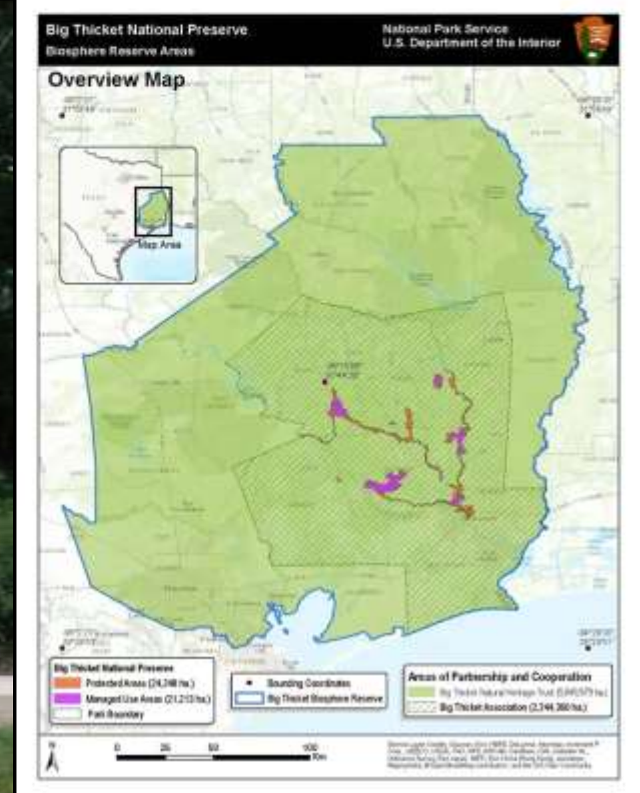
Above Permanent Waterline

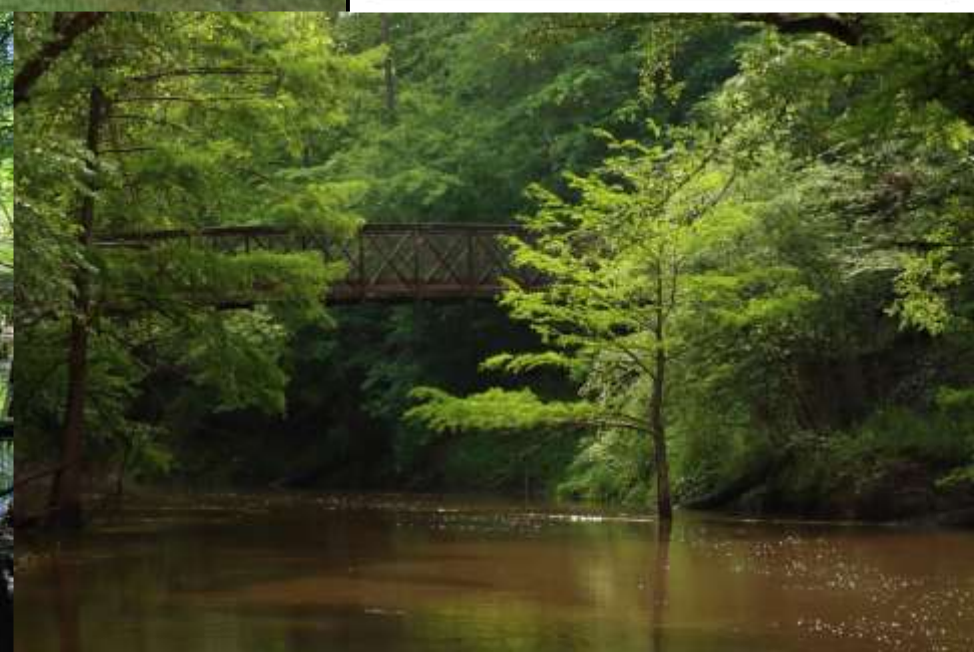
American Elm	Hackberry
Honey Locust	Yaupon
Roughleaf dogwood	Cedar elm
Eve’s Necklace	Eastern gamagrass
Box elder	Big bluestem
Buttonbush	Indiangrass
Green ash	Little bluestem
Baccharis	Virginia wildrye
Black willow	Texas bluegrass
Western soapberry	Purpletop
Pecan	Inland sea-oats
Bur oak	Texas wintergrass
Cottonwood	Maximilian sunflower
Sycamore	Illinois bundleflower
Little walnut	Dogbane
False indigo	Mustang grape
Wafer ash (Hop tree)	Herbaceous mimosa
Live oak	Redbud
Mulberry	Gum Bumelia



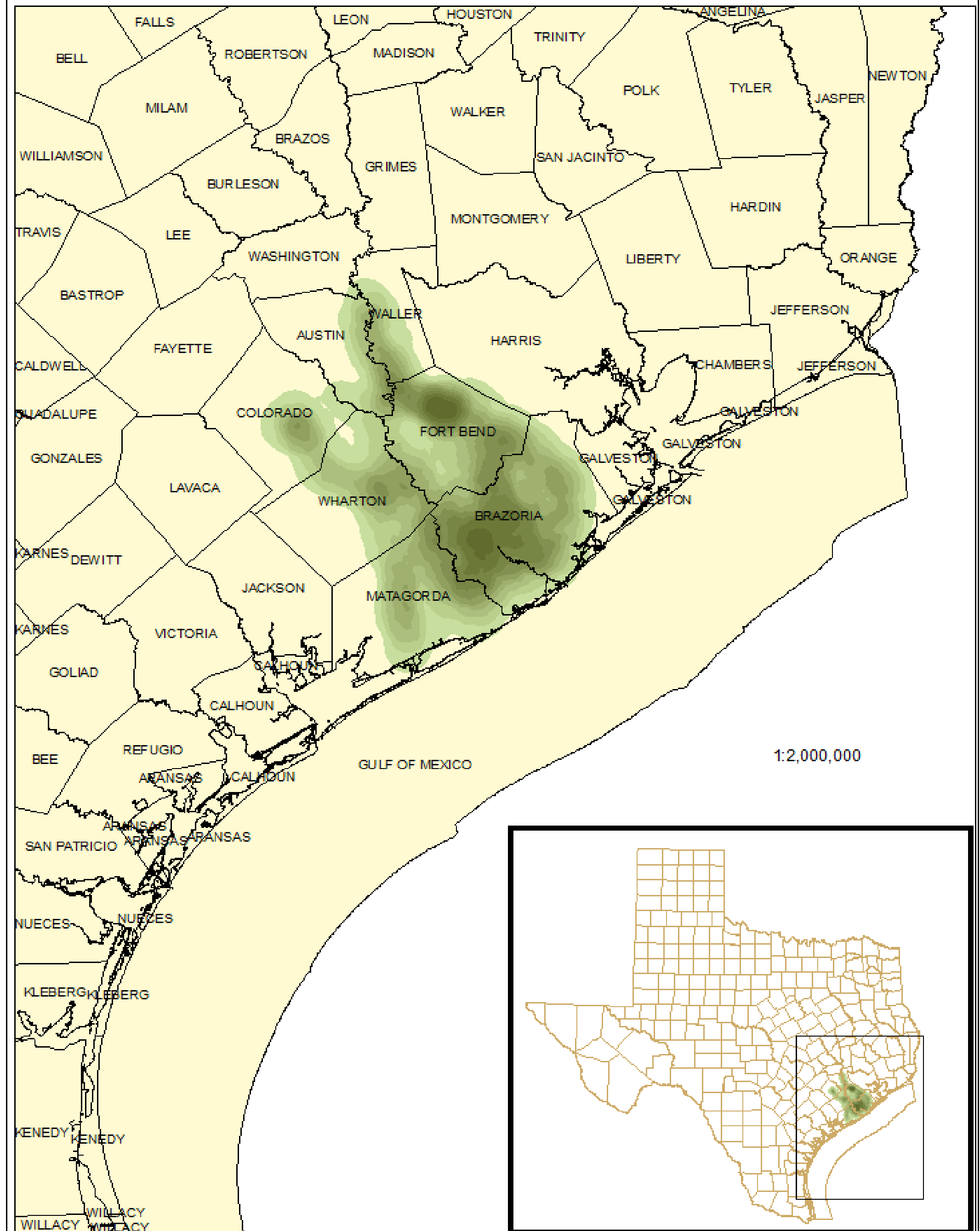
Bottomland Forest - Vertical structure


BIG THICKET
NATIONAL PRESERVE
Visitor Center


Big Thicket National Preserve
Biosphere Reserve Areas
National Park Service
U.S. Department of the Interior
Overview Map
Map Area
Big Thicket National Preserve
Protected Areas
Managed Use Areas (21,213 ha.)
Park Boundary
Bounding Coordinates
Big Thicket Biosphere Reserve
Areas of Partnership and Cooperation
Big Thicket Association
0
25
50
100



Columbia Bottomlands: Hardwood Forest and Woodland

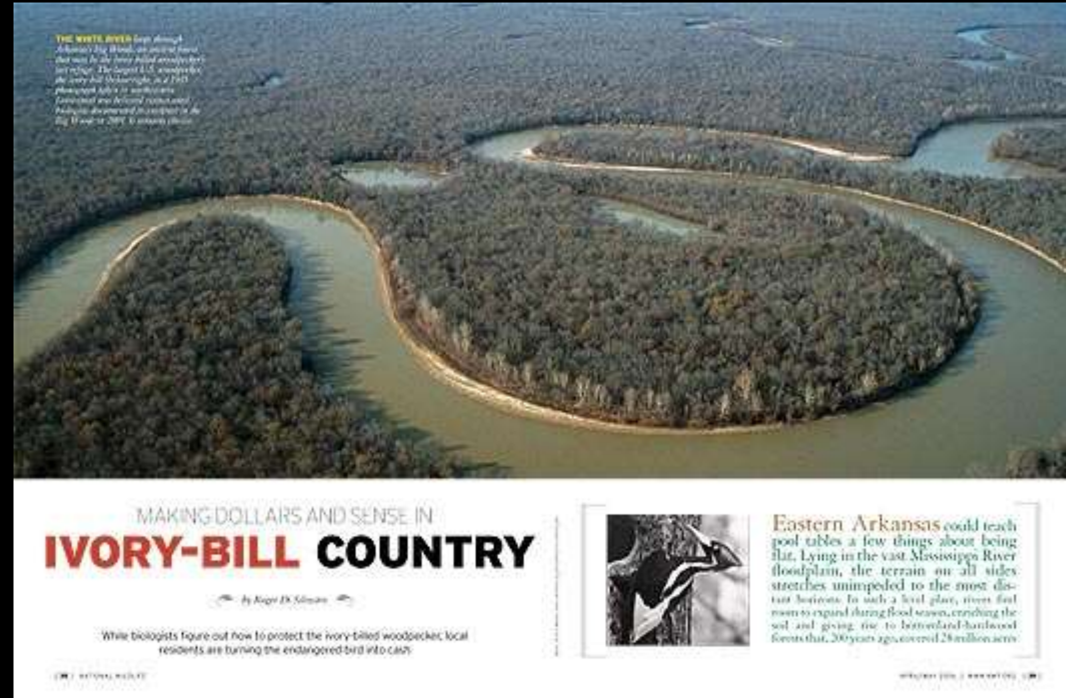


Bottomland Faunal Biodiversity

Table 1
PIF Physiographic Regions that Identify Bottomland Hardwoods and Forested Wetlands as Priority Habitats for Conservation with Associated Priority Bird Species[1]

PIF Priority Species	Subtropical Florida (01)	Peninsular Florida (02)	South Atlantic Coastal Plain (03)	East Gulf Coastal Plain (04)	Mississippi Alluvial Valley (05)	Coastal Prairies (06)	Interior Low Plateaus (18)	Ozarks and Ouachitas (19)	West Gulf Coastal Plain (42)	Mid-Atlantic Coastal Plain (44)
Acadian Flycatcher							X	X		
American Redstart							X			
Black-throated Green Warbler[2]			X							
Blue-gray Gnatcatcher					X					
Carolina Chickadee					X			X		X
Cerulean Warbler			X	X	X		X	X	X	X
Chimney Swift				X						X
Great-crested Flycatcher								X		
Hooded Warbler			X						X	
Kentucky Warbler				X	X			X	X	X
Louisiana Waterthrush								X	X	
Northern Parula			X		X		X			
Ovenbird								X		
Pileated Woodpecker								X		
Prothonotary Warbler			X	X	X	X	X	X	X	X
Red-headed Woodpecker				X	X				X	
Ruby-throated Hummingbird					X					
Scarlet Tanager										X
Summer Tanager			X					X		
Swainson's Warbler			X	X	X	X	X	X	X	X
Swallow-tailed Kite	X	X	X	X	X	X			X	
Yellow-billed Cuckoo			X	X	X			X	X	
Yellow-throated Vireo			X							X
Yellow-throated Warbler							X	X		
Wood Thrush			X		X		X			X
Worm-eating Warbler			X	X	X			X	X	X

[1] The "X" denotes priority species identified by PIF within each physiographic region.
[2] Refers to a subspecies, Wayne's Black-throated Green Warbler (*Dendroica virens waynei*), that breeds along the Atlantic coast in cypress swamps.



MAKING DOLLARS AND SENSE IN

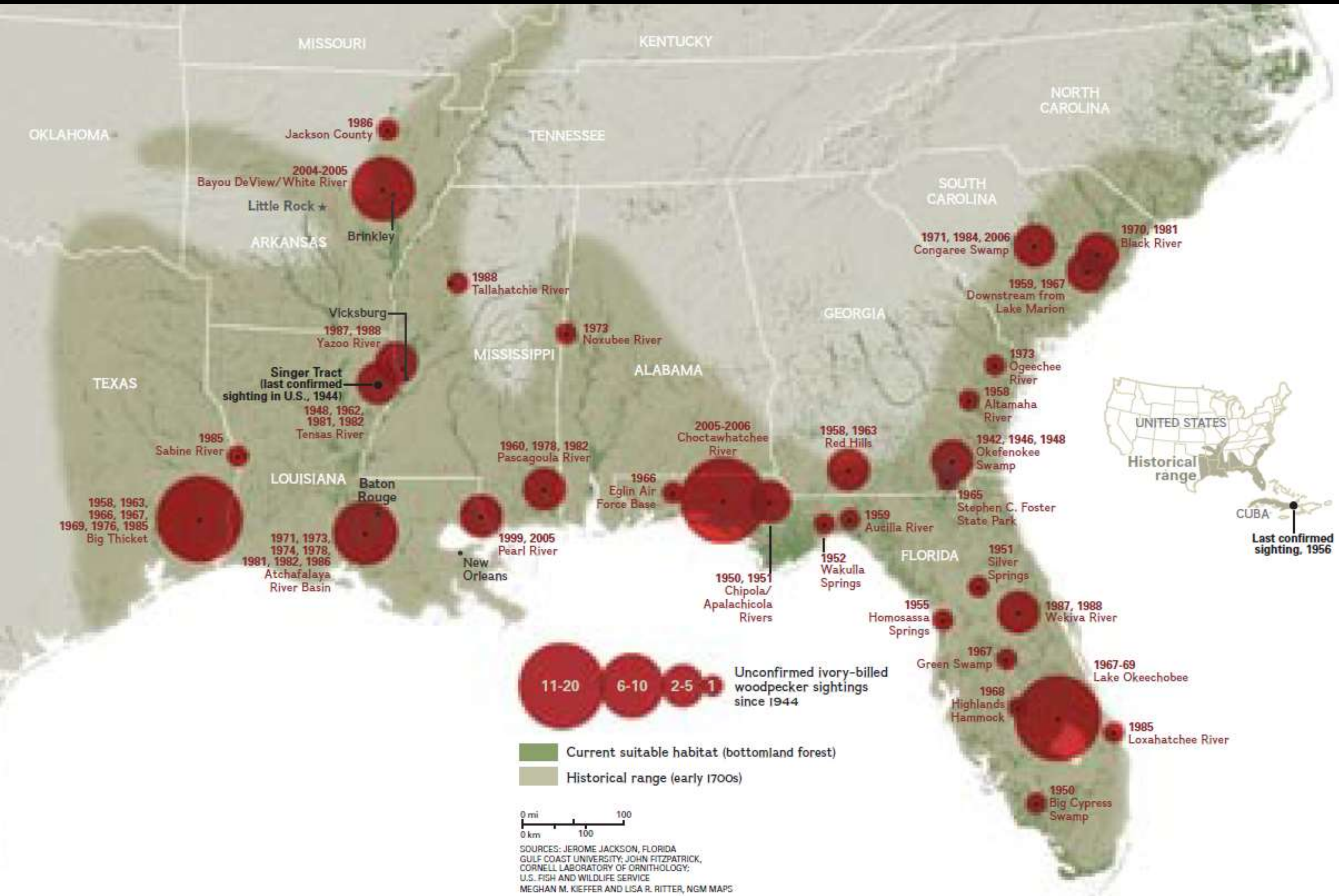
IVORY-BILL COUNTRY

While biologists figure out how to protect the ivory-billed woodpecker, local residents are turning the endangered bird into cash

Eastern Arkansas could teach pool tables a few things about being flat. Lying in the vast Mississippi River floodplain, the terrain on all sides stretches unimpeded to the most distant horizons. In such a level place, rivers find room to expand during flood season, enriching the soil and giving rise to bottomland-hardwood forests that, 200 years ago, covered 24 million acres

NWF SPEAKS OUT

PROTECTING IVORY-BILL WOODPECKER HABITAT


MISSOURI
KENTUCKY
OKLAHOMA
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
ARKANSAS
Little Rock
Brinkley
GEORGIA
MISSISSIPPI
ALABAMA
TEXAS
LOUISIANA
Baton Rouge
New Orleans
FLORIDA
1986 Jackson County
2004-2005 Bayou DeView/White River
1988 Tallahatchie River
Vicksburg
1987, 1988 Yazoo River
Singer Tract (last confirmed sighting in U.S., 1944)
1948, 1962, 1981, 1982 Tensas River
1973 Noxubee River
1985 Sabine River
1958, 1963, 1966, 1967, 1969, 1976, 1985 Big Thicket
1971, 1973, 1974, 1978, 1981, 1982, 1986 Atchafalaya River Basin
1999, 2005 Pearl River
1960, 1978, 1982 Pascagoula River
1966 Eglin Air Force Base
2005-2006 Choctawhatchee River
1950, 1951 Chipola/ Apalachicola Rivers
1952 Wakulla Springs
1958, 1963 Red Hills
1959 Aucilla River
1971, 1984, 2006 Congaree Swamp
1970, 1981 Black River
1959, 1967 Downstream from Lake Marion
1973 Ogeechee River
1958 Altamaha River
1942, 1946, 1948 Okefenokee Swamp
1965 Stephen C. Foster State Park
1951 Silver Springs
1955 Homosassa Springs
1987, 1988 Wekiva River
1967 Green Swamp
1967-69 Lake Okeechobee
1968 Highlands Hammock
1985 Loxahatchee River
1950 Big Cypress Swamp
UNITED STATES
Historical range
CUBA
Last confirmed sighting, 1956
11-20
6-10
2-5
1
Unconfirmed ivory-billed woodpecker sightings since 1944
Current suitable habitat (bottomland forest)
Historical range (early 1700s)
0 mi 100
0 km 100
SOURCES: JEROME JACKSON, FLORIDA GULF COAST UNIVERSITY; JOHN FITZPATRICK, CORNELL LABORATORY OF ORNITHOLOGY; U.S. FISH AND WILDLIFE SERVICE
MEGHAN M. KIEFFER AND LISA R. RITTER, NGM MAPS

Identifying Field Marks of an Ivory-billed Woodpecker and Similar Birds

In flight - view from below

Distinct Ivory-billed Woodpecker characteristics:

- White trailing edge of wing (vs. dark trailing edge of Pileated).
- Wing more slender than Pileated.
- Tail feathers longer and more pointed.
- Pale, ivory-white bill.

In flight - view from above

Distinct Ivory-billed Woodpecker characteristics

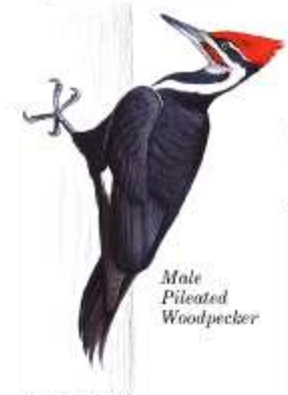
- White trailing edge of wing (vs. dark trailing edge of Pileated).
- Two white stripes converge on lower back.
- Tail feathers longer and more pointed.
- Pale, ivory-white bill.

Illustrations: © David Allen Sibley

At rest

Distinct Ivory-billed Woodpecker characteristics

- Two white stripes converge on lower back.
- Entirely white secondary feathers give appearance of white "saddle" on back.
- Largely dark face and dark chin (vs. white chin of Pileated).
- Pale, ivory-white bill.
- Crest is curved and pointed; male crest is red with black forehead (Pileated male crest is entirely red).

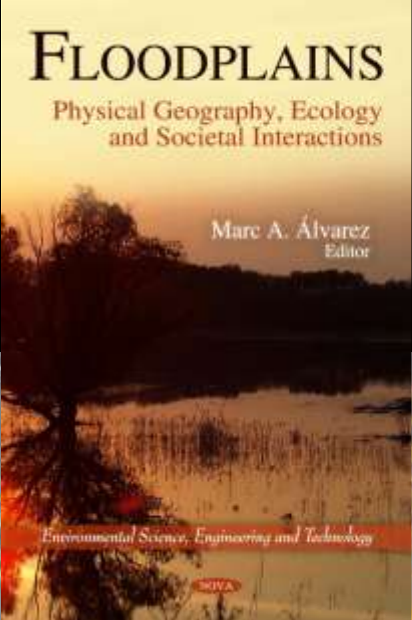


Female Head

- Female Ivory-bill crest is entirely black (female Pileated crest resembles male ivory-billed red crest with black forehead – use chin color as distinguishing feature)

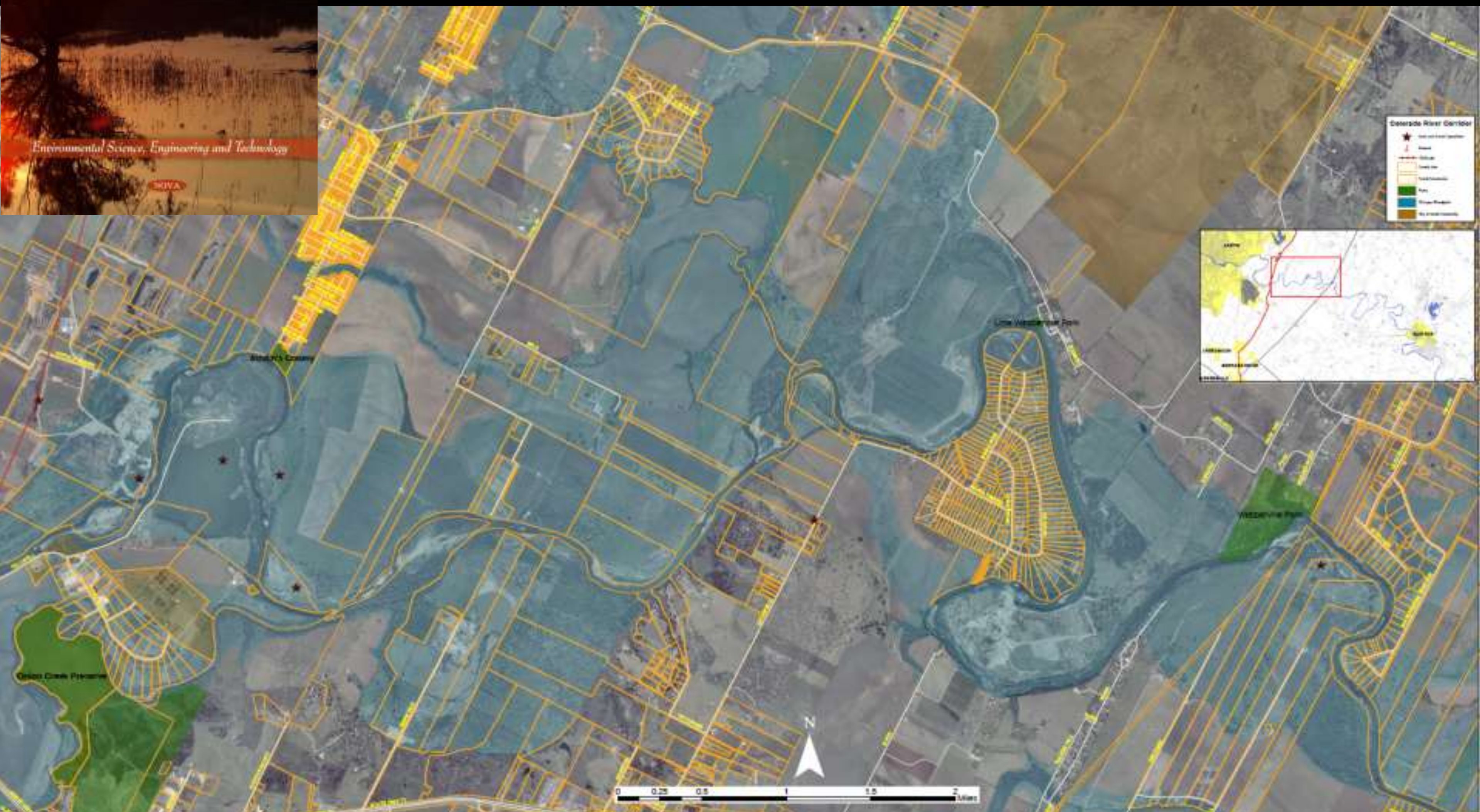
Bottomland Bird – Hornsby Bend

Black-bellied Whistling Duck



Life on the Floodplain

Humans settle in the bottomland



The Overlooked Entrada: The Espinosa-Olivares-Aguirre Expedition of 1709

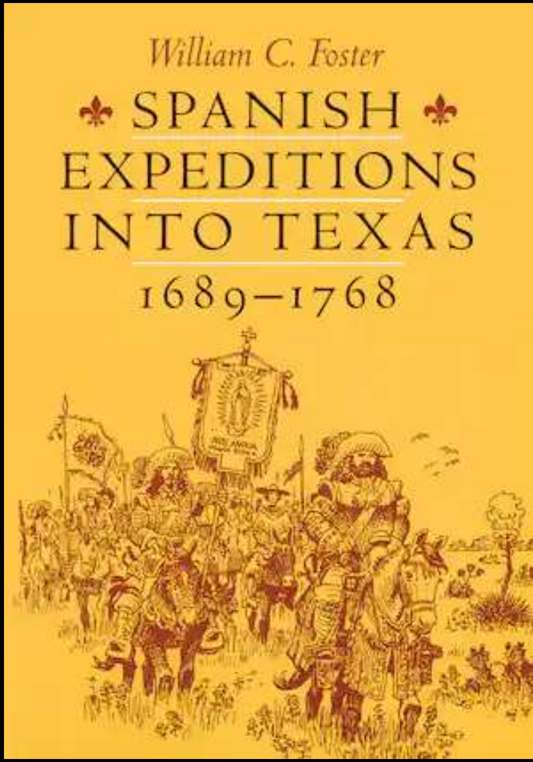
By Anibal Gonzalez

[Sayersville Historical Association Bulletin]

In April 1709, two Franciscan priests and 15 soldiers cam from the Rio Grande all the way to the Colorado looking for a delegation of Tejas Indians they never found…it is probable that they camped not far above the Hornsby Bend of the Colorado in Eastern Travis County.

"We came to the river, which has a guard on either side of luxuriant trees, nut trees [nogales], ash trees, poplars [cottonwood], elms, willows, mulberries, and wild grapevines much taller and thicker than those in Castile. It has sand banks which mark how high it rises, a quarter of a league wide. The water is of the best we have found."

Difficulty traveling downriver because "the monte that offered itself to our sight was so much that we could not penetrate it." Followed buffalo trails along the upland post oaks.

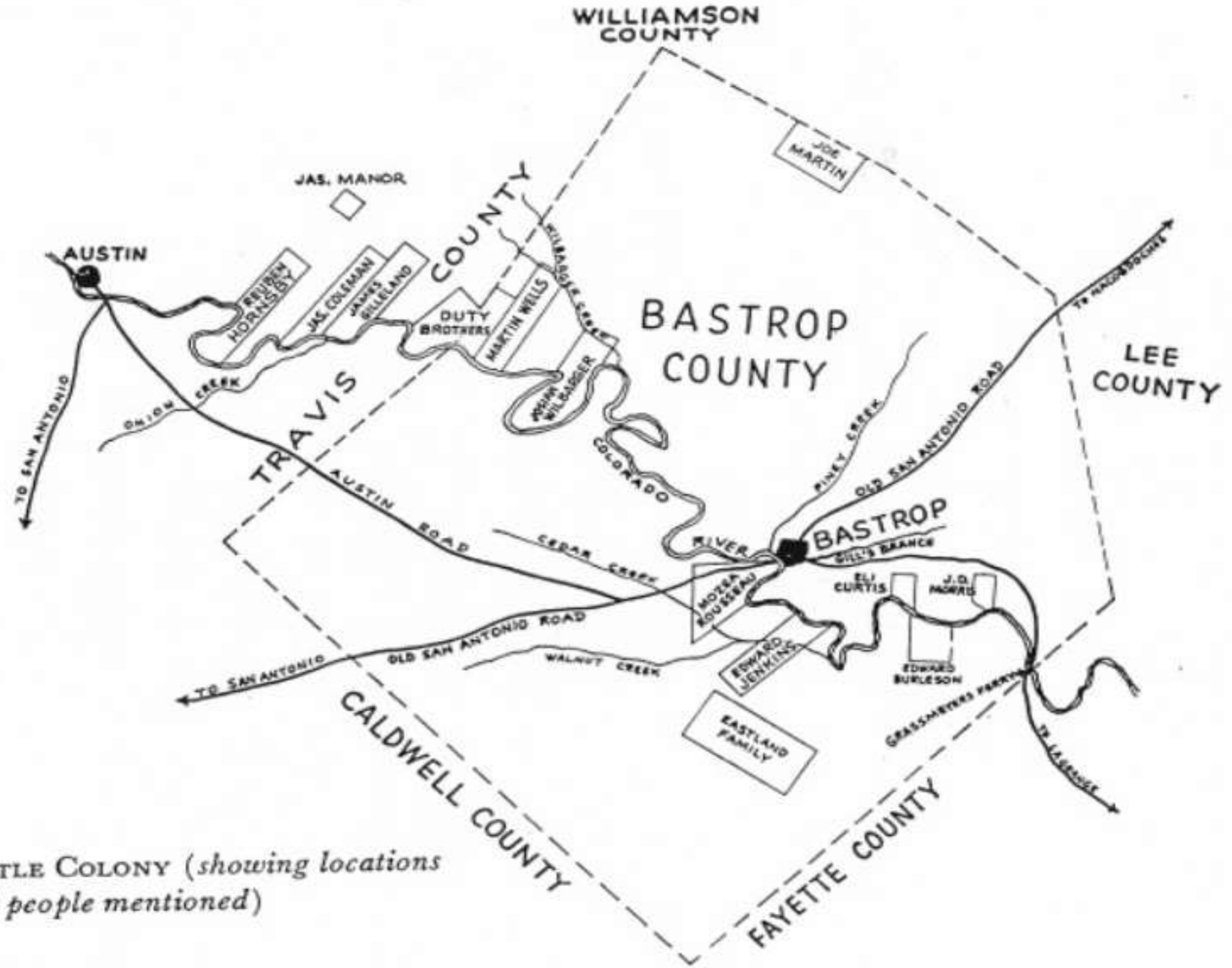


The Bottomland Forest

El Monte Grande [del Diablo]

Monte – a sizable almost impenetrable forest – a thicket

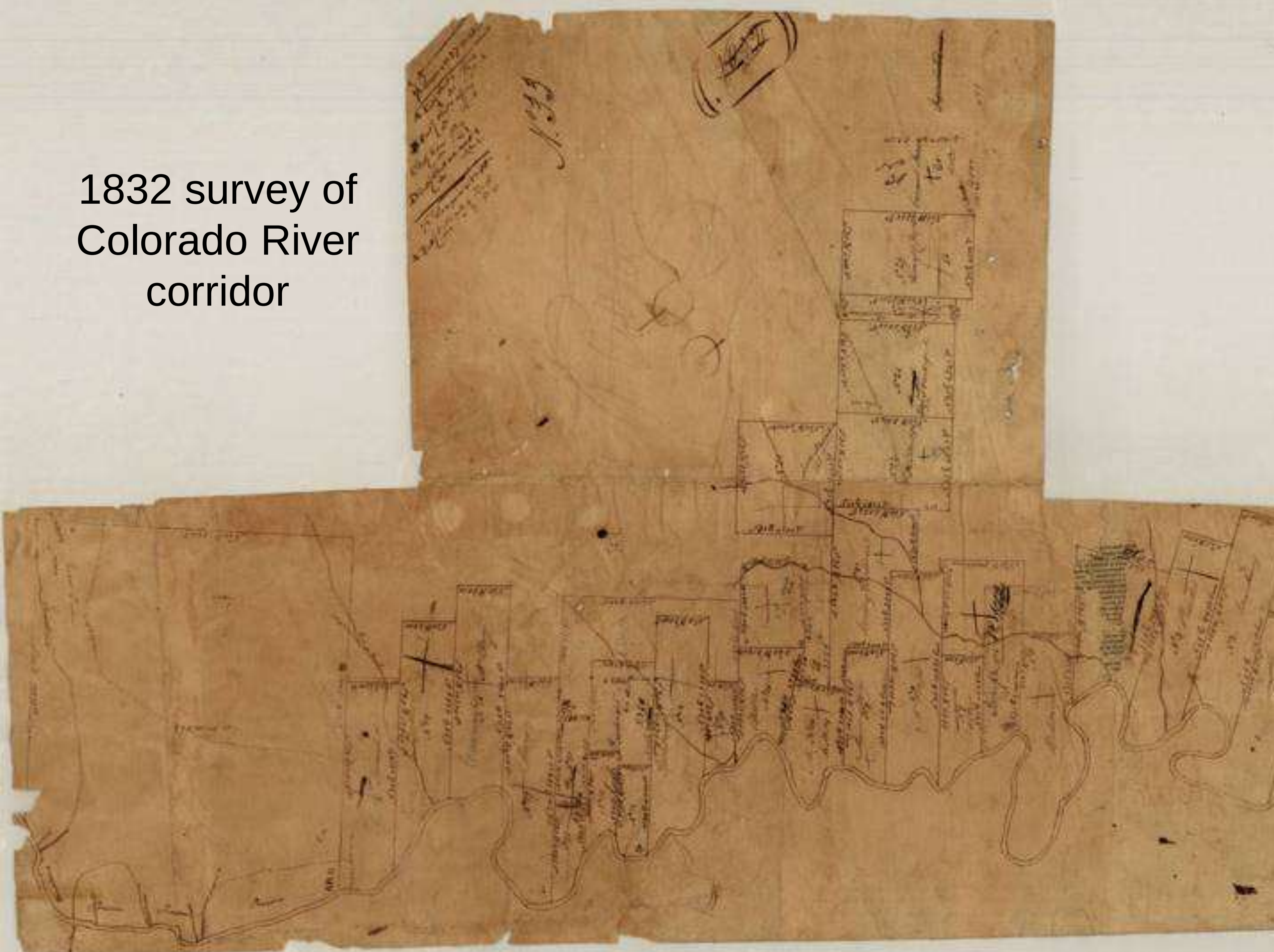
Settlement begins 1820's along river corridor

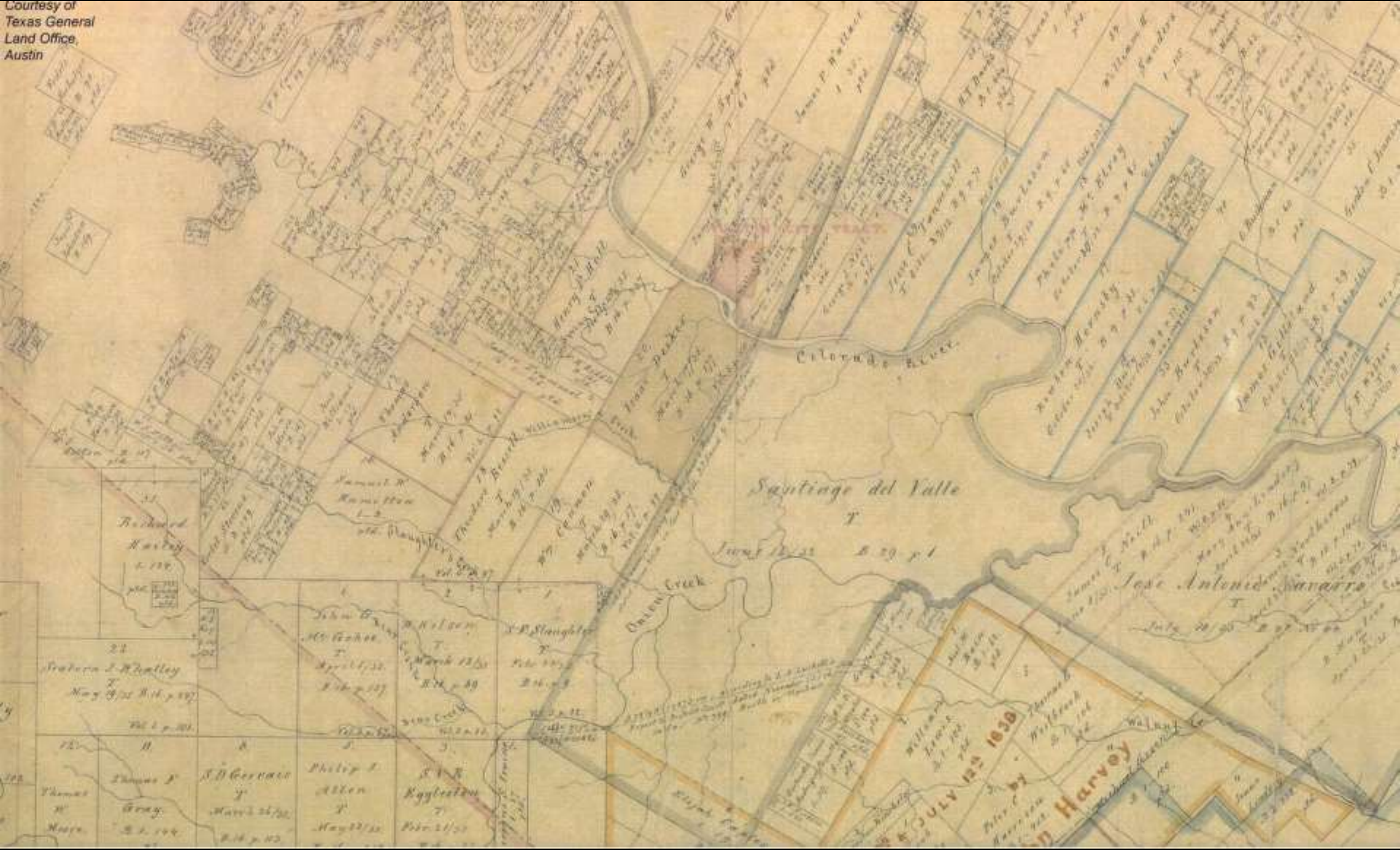


AUSTIN'S LITTLE COLONY (*showing locations of homes of people mentioned*)


BASTROP.
Jose Manuel Bangs.
Bastrop Town Tract
Stephen F. Austin
Confirmed
Isaac Harris
Leman Barker
S.M. Williams
Josaiah Wilbarger
James Haggard
Nancy Blackey
Colorado River
Navarro
Martin Wells
J.B. Walters
J. Rogers
B. 30. p. 260.

1832 survey of Colorado River corridor

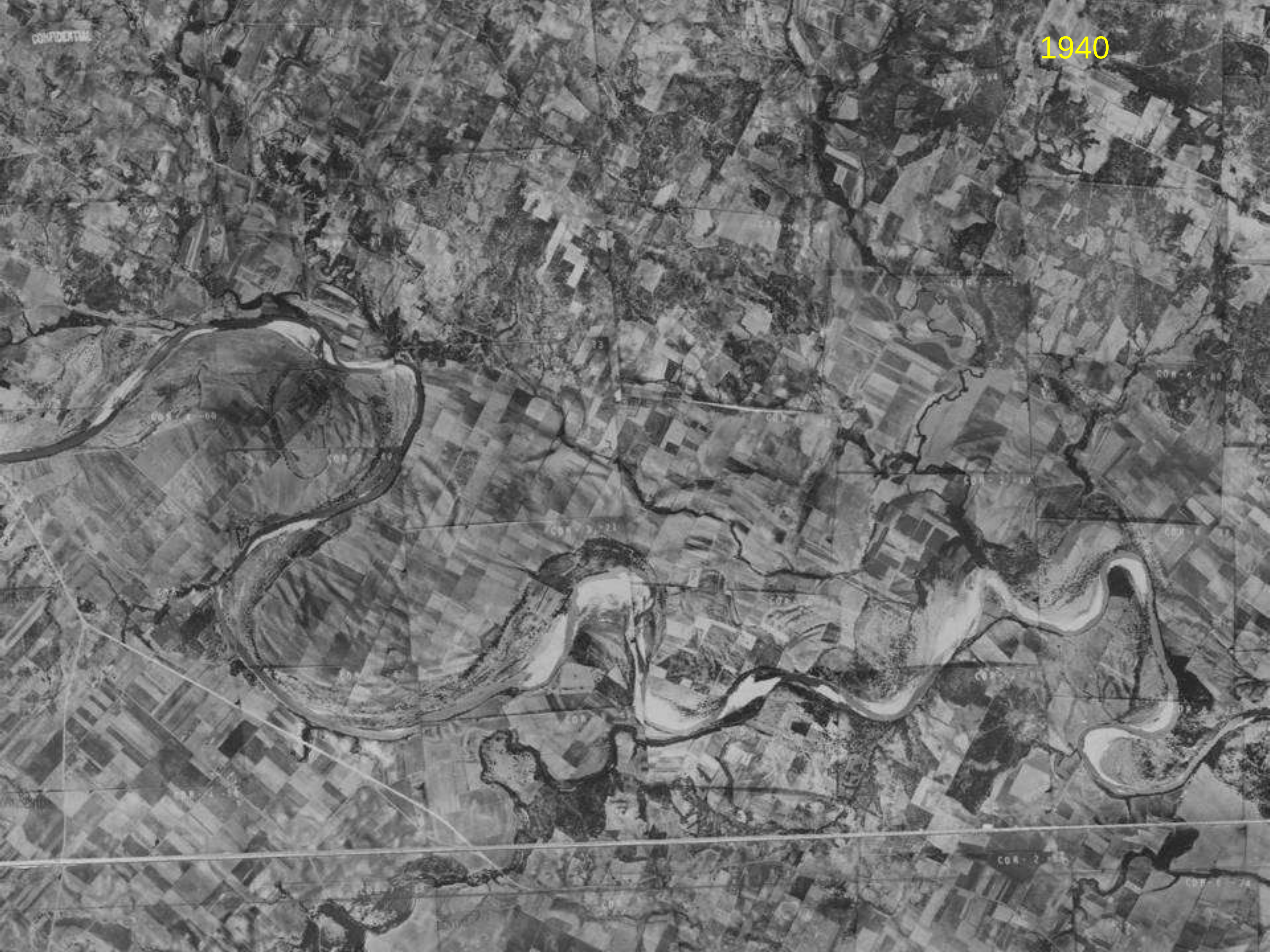



Courtesy of
Texas General
Land Office,
Austin
Colorado River
Santiago del Valle
Onion Creek
Jose Antonio Navarro

1861


AUSTIN
Fort Prairie
TEXAS
AND
HOUSTON
Boggy Creek
STONES FORD
Montopolis
Hornsby
Becker
Creek
Elm
Creek
Dunlap
Hunter
Webberville
THREE ISLAND FORD
COLORADO
RIVER
West Base
Delvalle
East Base
Garfield
McKinney Falls
Creek
Onion
Moore & Berry's Store
Elysium
Creek

1886


CONFIDENTIAL
1940


Hornsby Bend
1998

Bottomland Forest

Elders

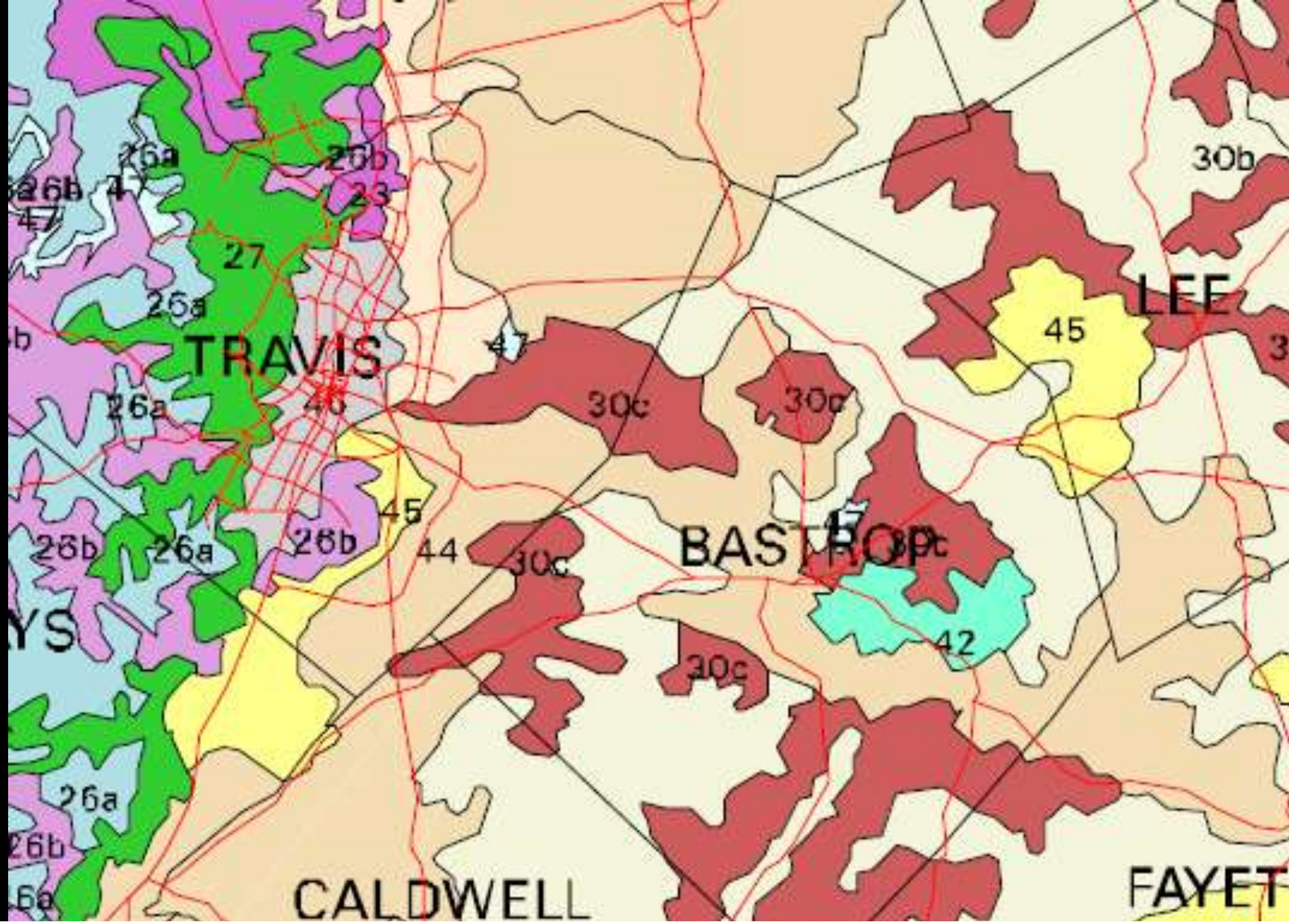
Pecans and Live Oaks

Native Flora

Vegetation map

TPWD

1980s



28	*Havard Shin Oak Brush (Quercus havardii)*
29	*Gray Oak - Pinyon Pine - Alligator Juniper Parks/Woods (Quercus grisea - Pinus cembroides - Juniperus deppeana)*
30a	*Post Oak Parks/Woods (Quercus stellata)*
30b	*Post Oak Woods, Forest, and Grassland Mosaic*
30c	*Post Oak Woods/Forest*
42	*Pine - Hardwood Forest*
43	*Marsh/Barrier Island*
44	*Crops*
45	*Other Native and/or Introduced Grasses*
46	*Urban*

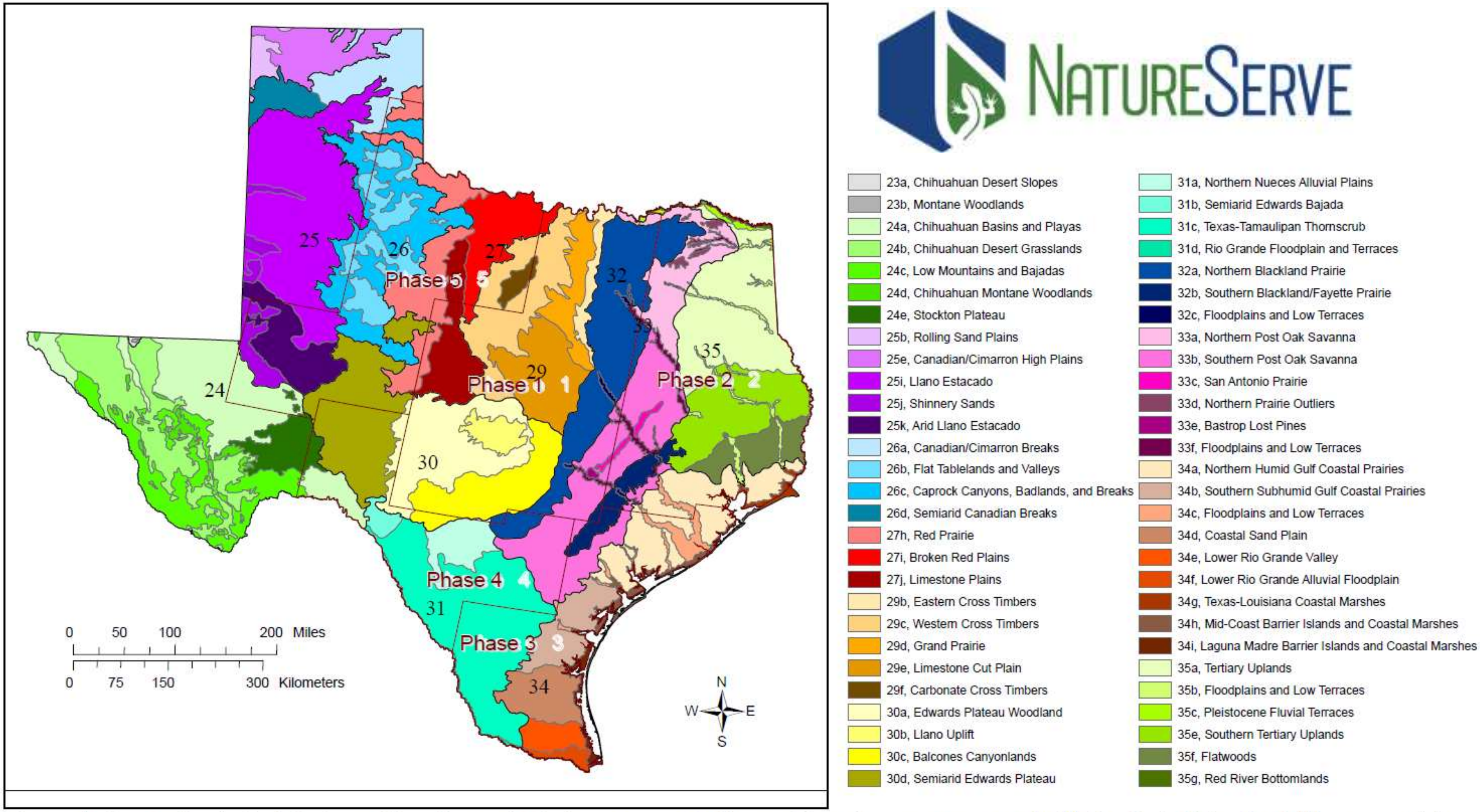


Figure 1. Texas Ecological Systems Mapping project phase map. Outlines of the phases correspond with the footprints of satellite scene data. The project will be completed in the early fall of 2012.

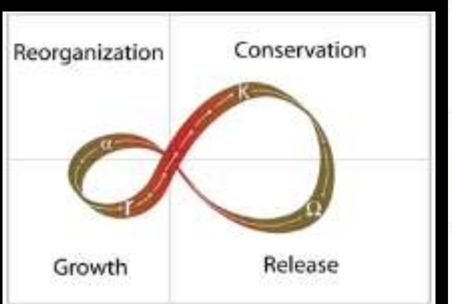
Contemporary Ecology of Texas - Texas Ecological Systems Project

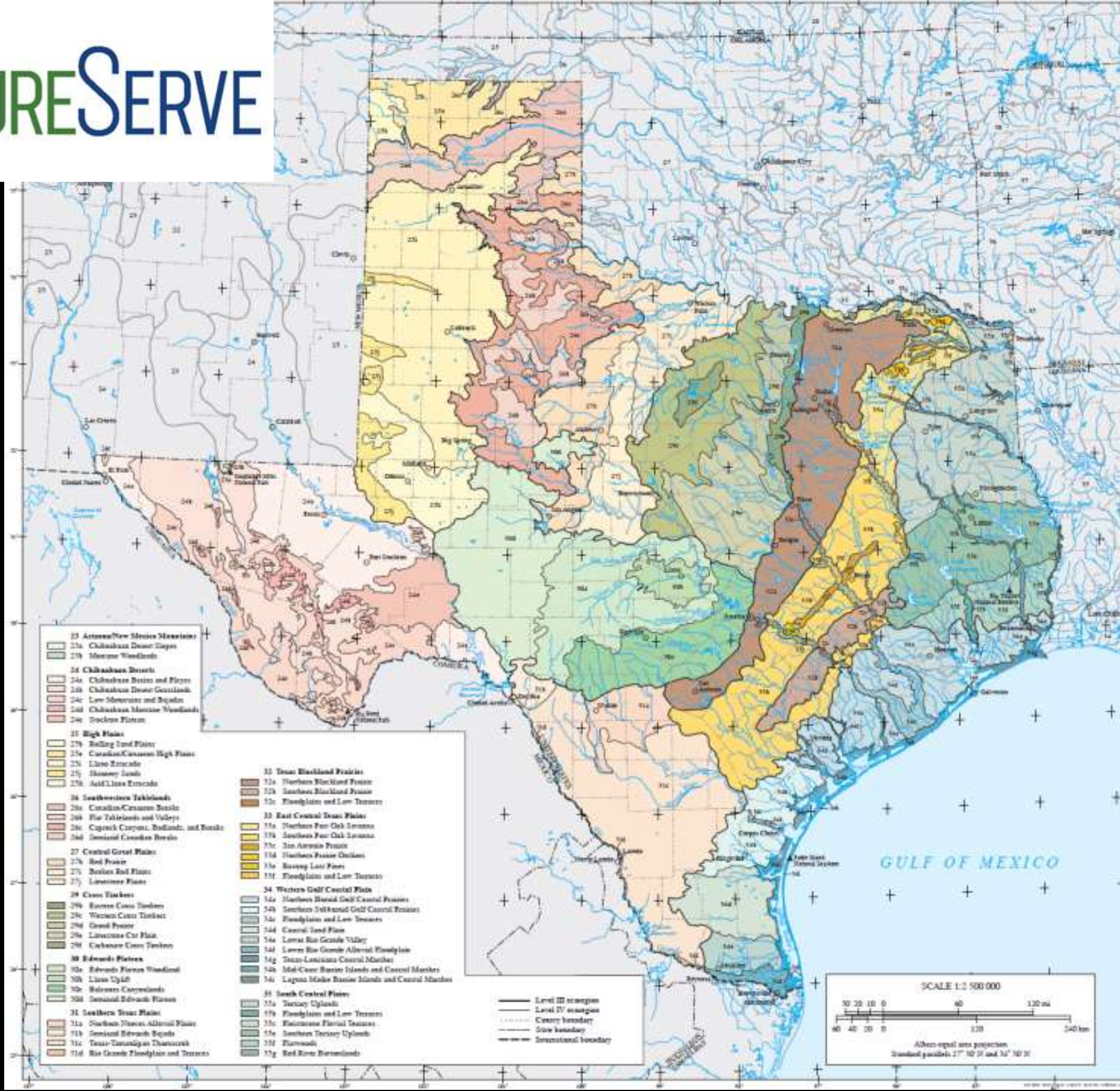
Part of the NatureServe Terrestrial Ecological Systems of the United States

2012

Contemporary Texas Ecology

Prospective Ecology vs. Retrospective Ecology





Southeastern Great Plains Floodplain Forest

- Central Texas: Floodplain Juniper Forest
- Central Texas: Floodplain Live Oak Forest
- Central Texas: Floodplain Hardwood / Evergreen Forest
- Central Texas: Floodplain Hardwood Forest
- Central Texas: Floodplain Evergreen Shrubland
- Central Texas: Floodplain Deciduous Shrubland
- Central Texas: Floodplain Herbaceous Vegetation

- Row Crops
- Grass Farm
- Urban High Intensity
- Urban Low Intensity
- Native Invasive: Deciduous Woodland
- Native Invasive: Juniper Woodland
- Native Invasive: Juniper Shrubland
- Native Invasive: Mesquite Shrubland
- Open Water
- Marsh
- Swamp

Southeastern Great Plains Riparian Forest

- Central Texas: Riparian Juniper Forest
- Central Texas: Riparian Live Oak Forest
- Central Texas: Riparian Hardwood / Evergreen Forest
- Central Texas: Riparian Hardwood Forest
- Central Texas: Riparian Evergreen Shrubland
- Central Texas: Riparian Deciduous Shrubland
- Central Texas: Riparian Herbaceous Vegetation


Hornsby Bend
1998

Resilience – The Return of the Bottomland Forest

Hornsby Bend 2022