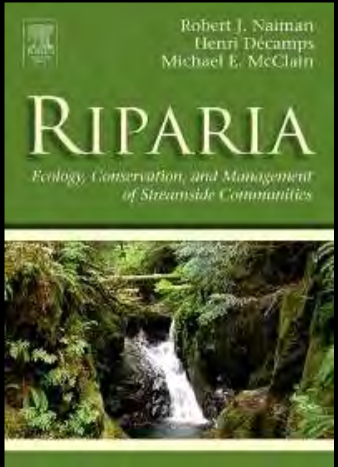
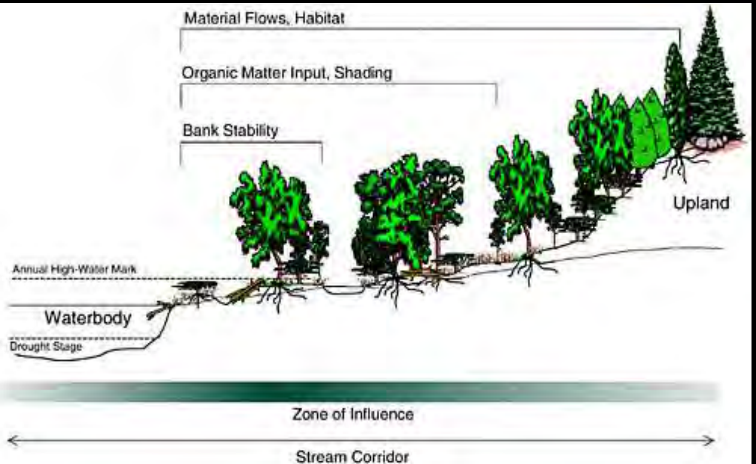
Center for Environmental Research at Hornsby Bend

Riparia: Life at the Edge

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

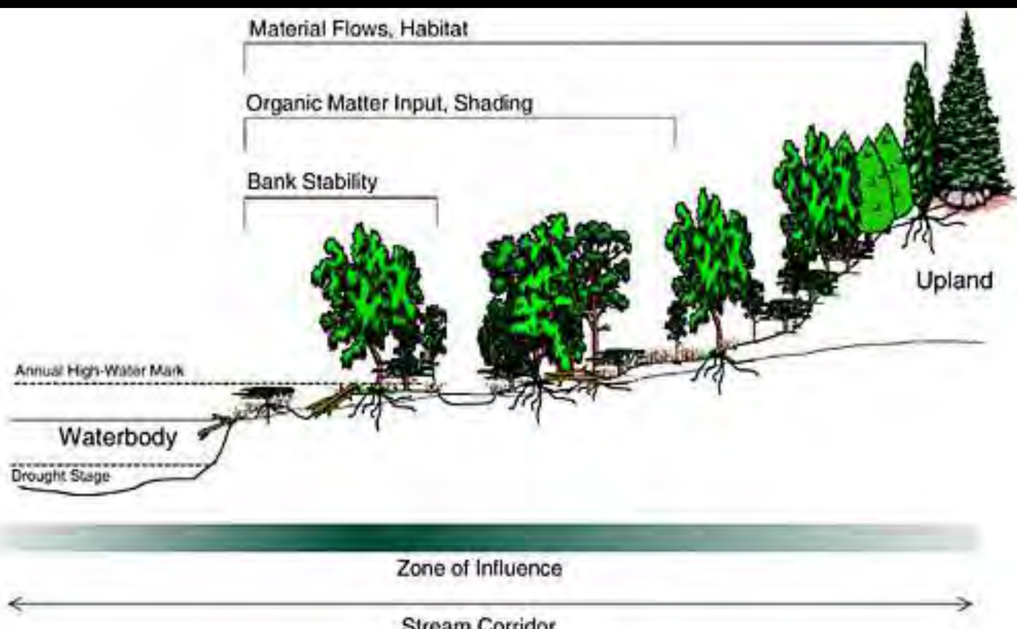


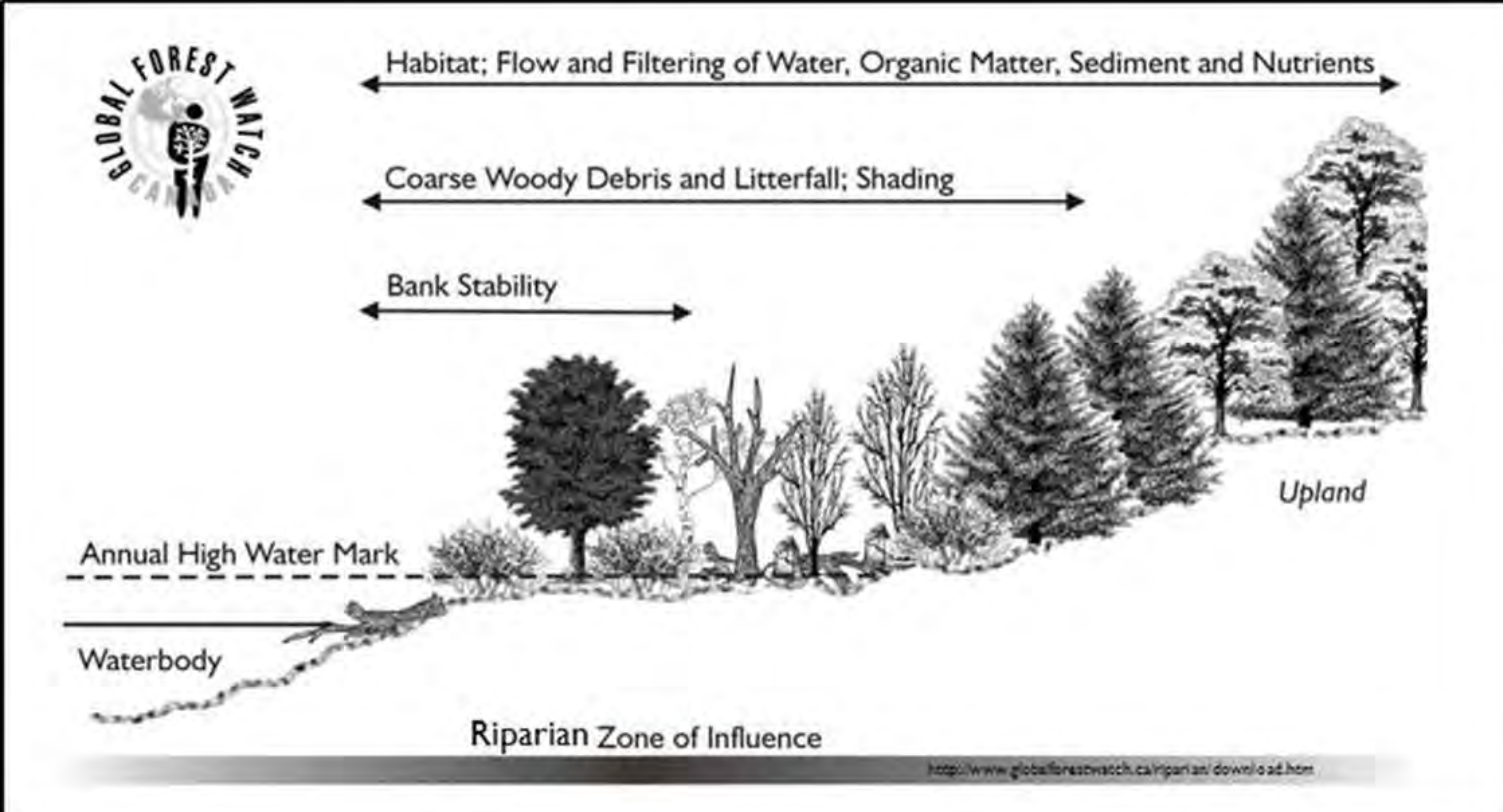


Riparian Zone = Waterway Margins

Riparian areas are transitional zones between terrestrial and aquatic ecosystems.

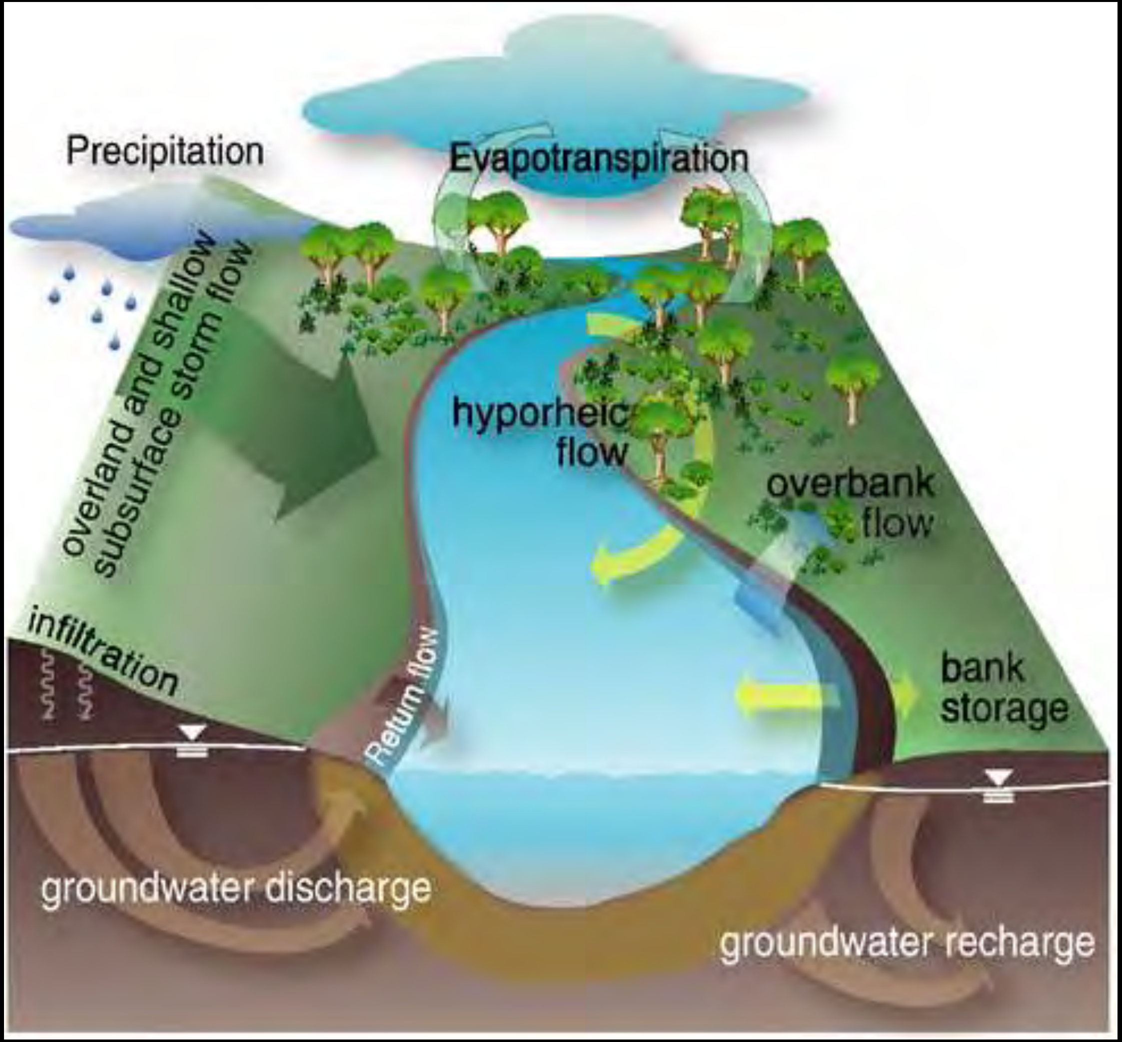
Vary in width depending on influence of water





Riparian zones include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems.

Hydric Soils

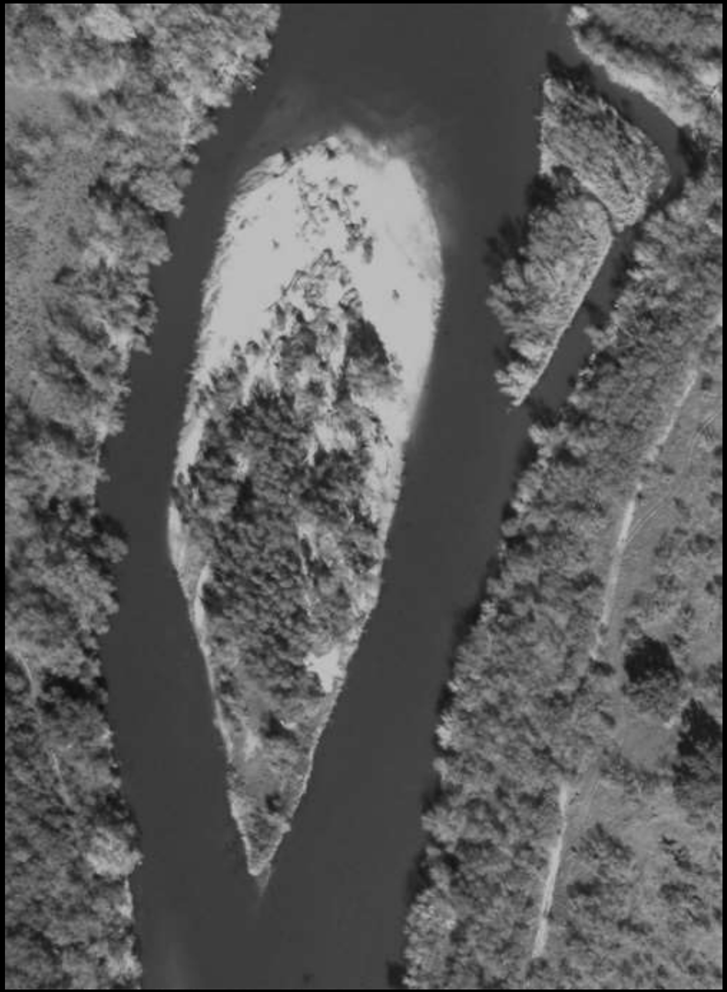


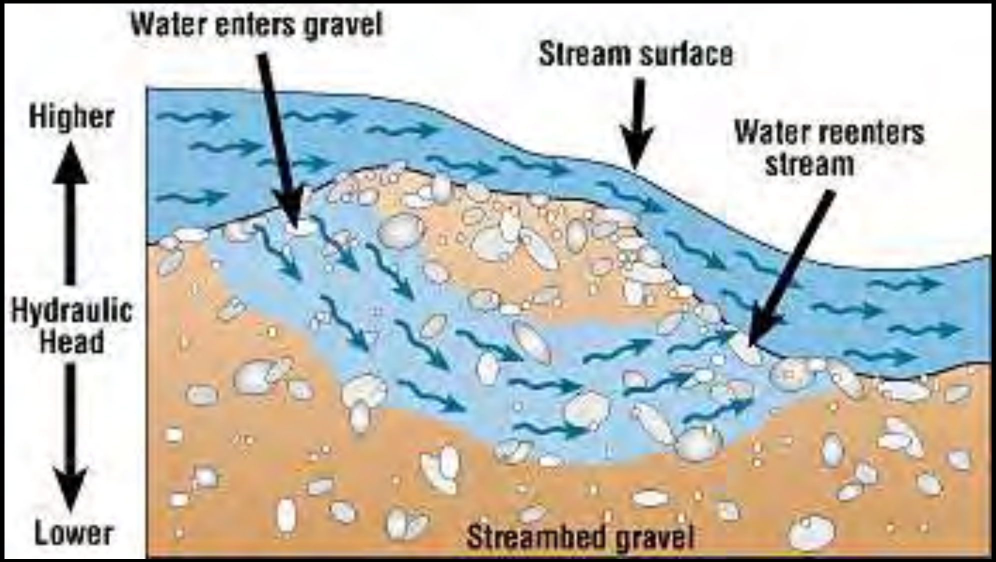
Riparian Zone and Hydrology

Hyporheic Flows
hypo (below) and rheos (flow)

They are areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands.

The Hyporheic Zone





The Hyporheic Zone Research at Hornsby Bend

Dr. Bayani Cardenas

UT Jackson School of Geosciences

THE UNIVERSITY OF TEXAS AT AUSTIN
JACKSON
SCHOOL OF GEOSCIENCES

Figure 1. Location of study site on the Colorado River in relation to Austin, Texas, USA. USGS gaging station 08158000 is 2 km downstream from Longhorn dam, and the study site is another 13 km downstream

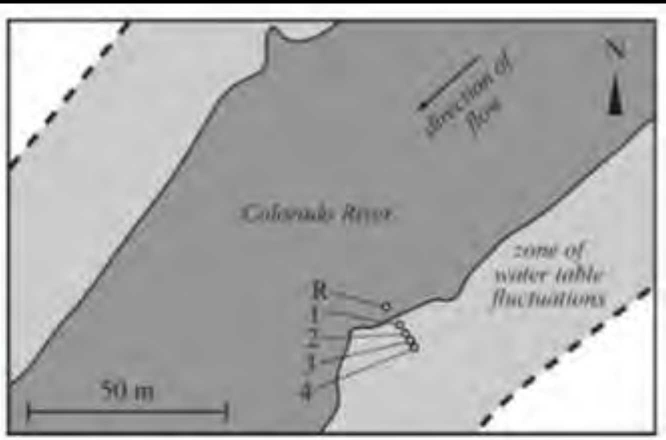


Figure 2. Map of Hornsby Bend piezometer transect. Bank piezometers are numbered in order of distance from the river, and the river stage recorder is denoted as (R). Dashed lines indicate the estimated extent of dam influence on the water table

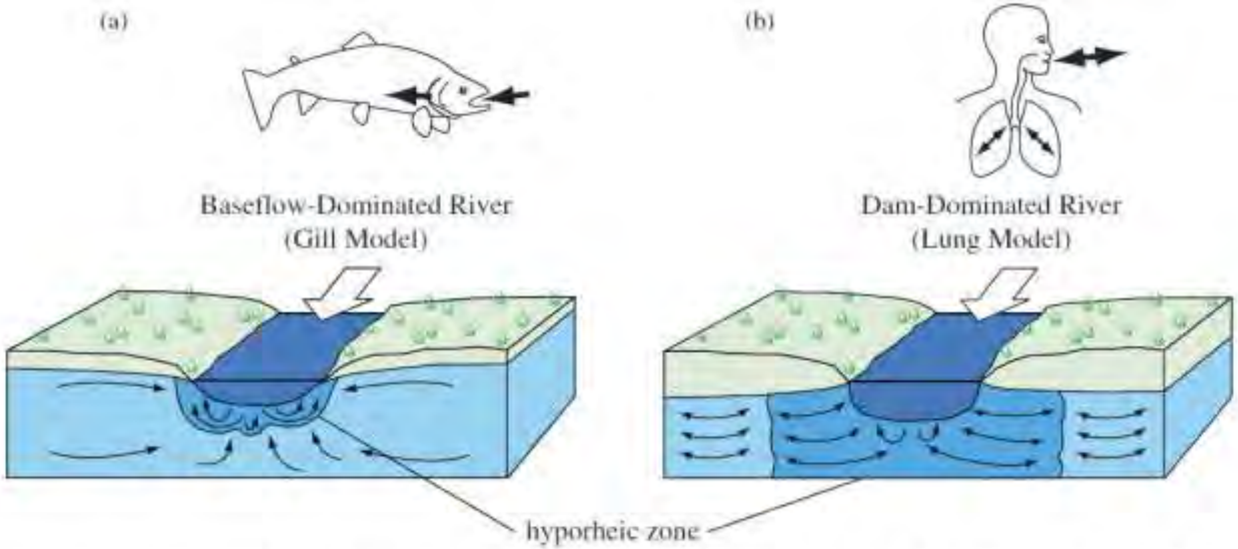


Figure 10. (a) Conceptual model of a natural river-groundwater system in a reach dominated by baseflow. During most of the year, groundwater flows steadily through the riparian aquifer in one direction like water through a gill. Groundwater discharge to the river limits the size of the hyporheic zone. (b) Conceptual model of a river-groundwater system downstream of a dam. Due to frequent stage fluctuations, river water flows in and out of the riparian aquifer like air flowing in and out of lungs. The hyporheic zone includes all flow paths that start and end in the channel

The Riparian Sponge

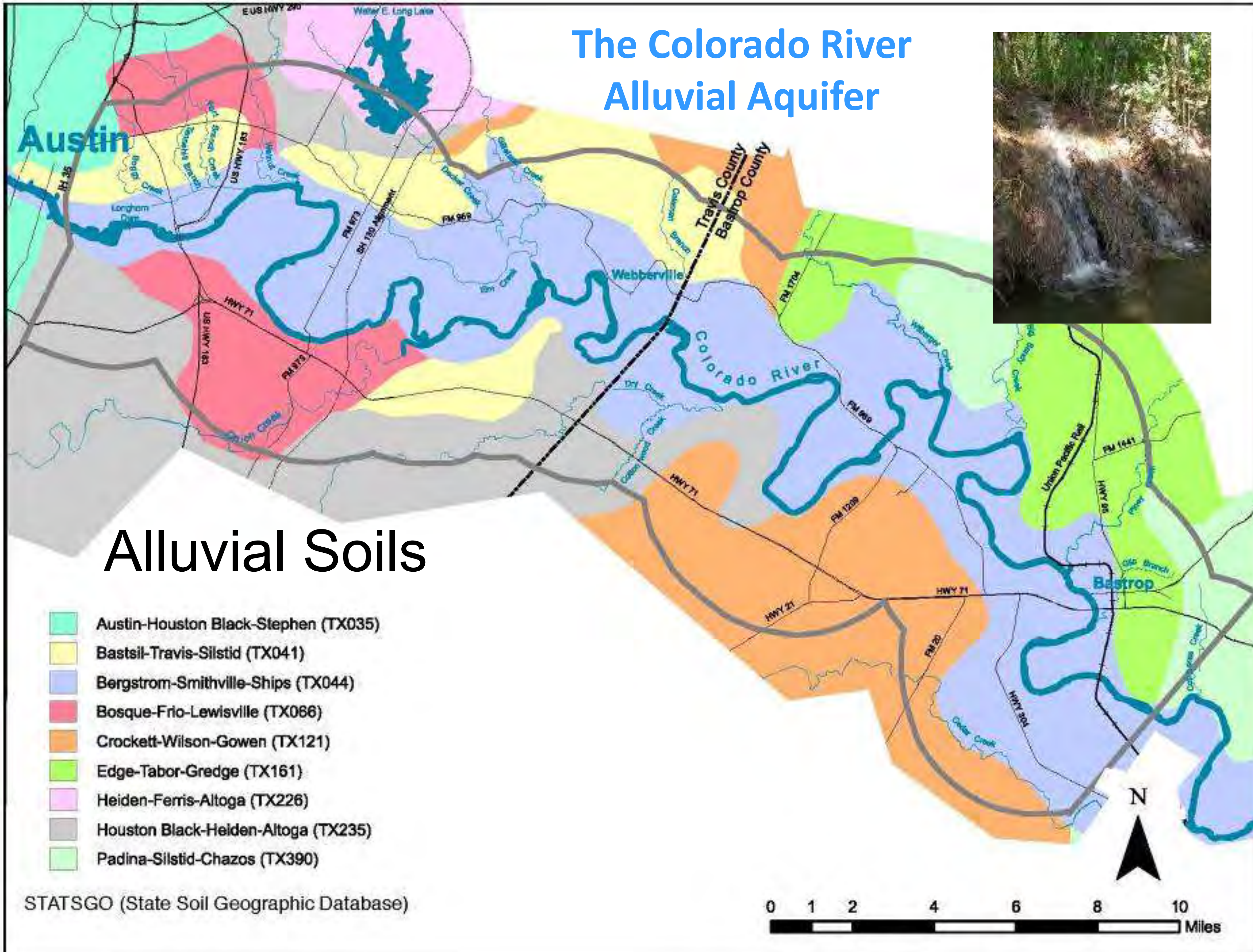
- One of the attributes of a properly functioning riparian area is the sponge effect and water storage capacity within the riparian area.
- This large absorbent sponge of riparian soil and roots will soak up, store, and then slowly release water over a prolonged period.
- This riparian sponge can be managed in a way to greatly increase and improve this storage or it can be managed in a way to decrease and degrade water storage.

Environmental Flows and the Riparian Sponge

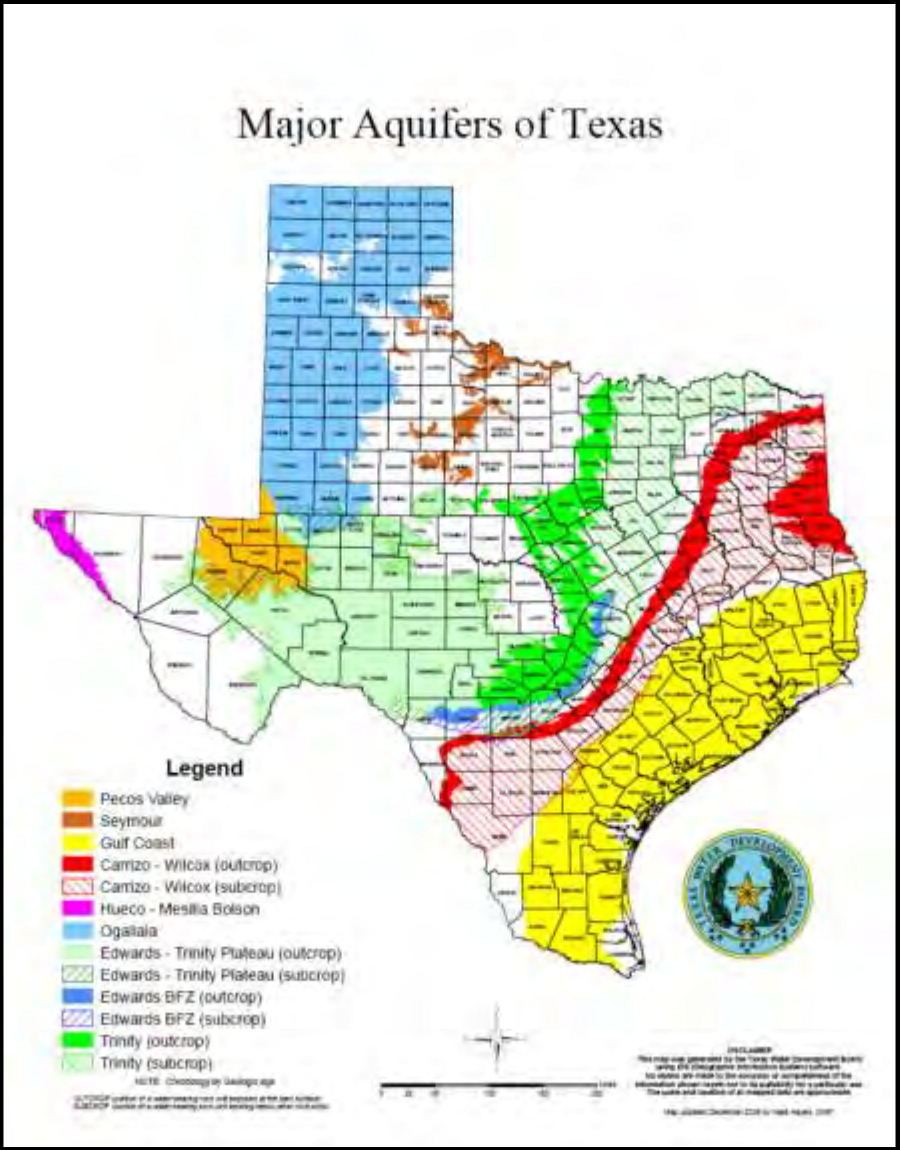
Storage capacity – Bear Creek, Central Oregon study

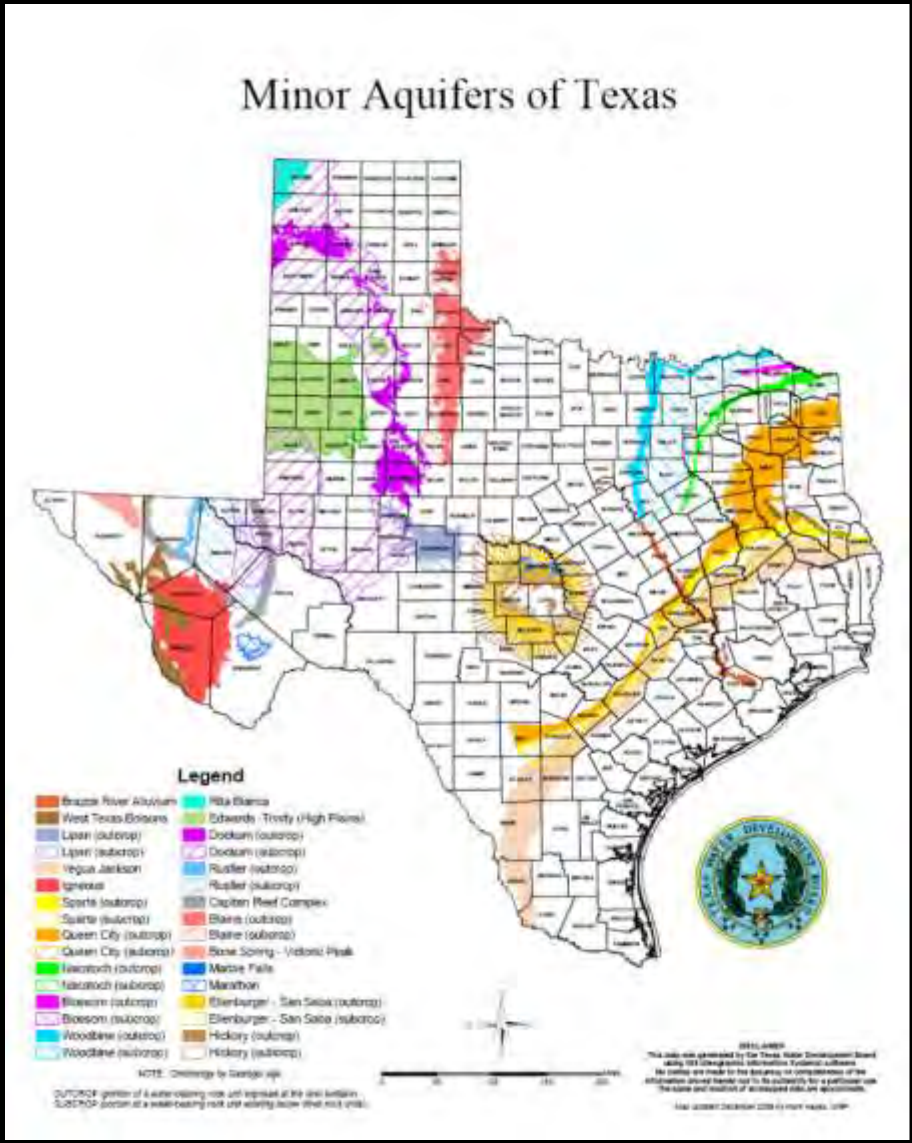
12 acres of riparian area per mile = 12 acre feet of water per mile

The Colorado River Alluvial Aquifer



Riparian Water in Texas?
Alluvial Aquifers?





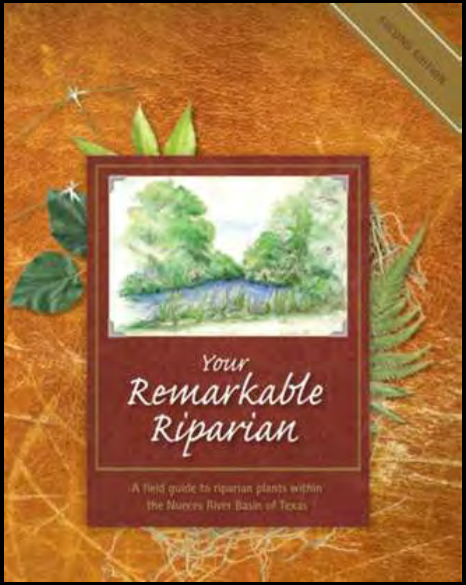
Texas Riparian Association

Founded 2001

Mission: To encourage healthy riparian systems within Texas

Texas - 3,700 named streams and 15 major rivers

www.texasriparian.org



Proper Functioning Condition

Riparian areas are functioning properly when adequate vegetation is present to:

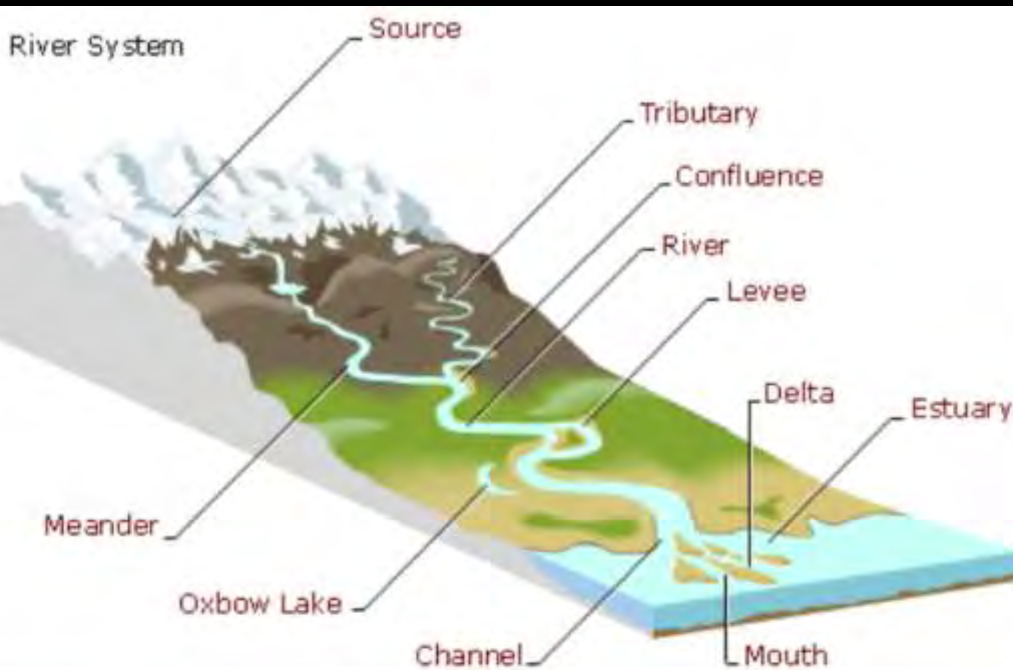
- dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality and quantity
- filter sediment, capture bedload, and aid in floodplain development; improve flood-water retention and groundwater recharge
- develop root masses that stabilize streambanks against cutting action and store water
- develop diverse ponding and channel characteristics to provide habitat and the water depth and temperature necessary for fish, waterfowl, benthic macroinvertebrates, and other fauna
- support greater biodiversity

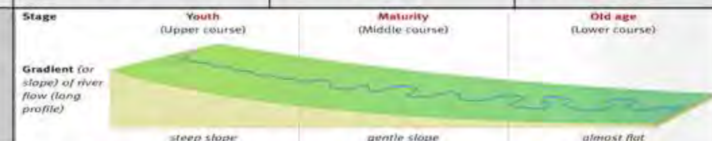
Riparian Zones and the River Course

The Upper Course: steep and rugged

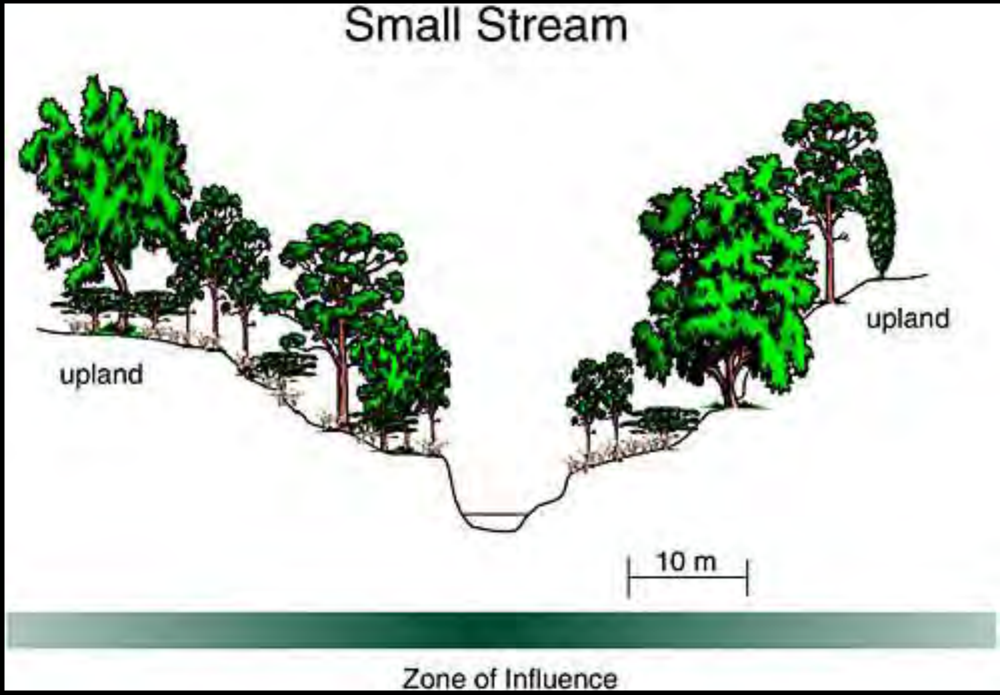
The Middle Course: winding sedately through wide valleys

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)

The Upper Course - Youthful Headwaters



Upper Course – Source
Critical Riparian Area

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

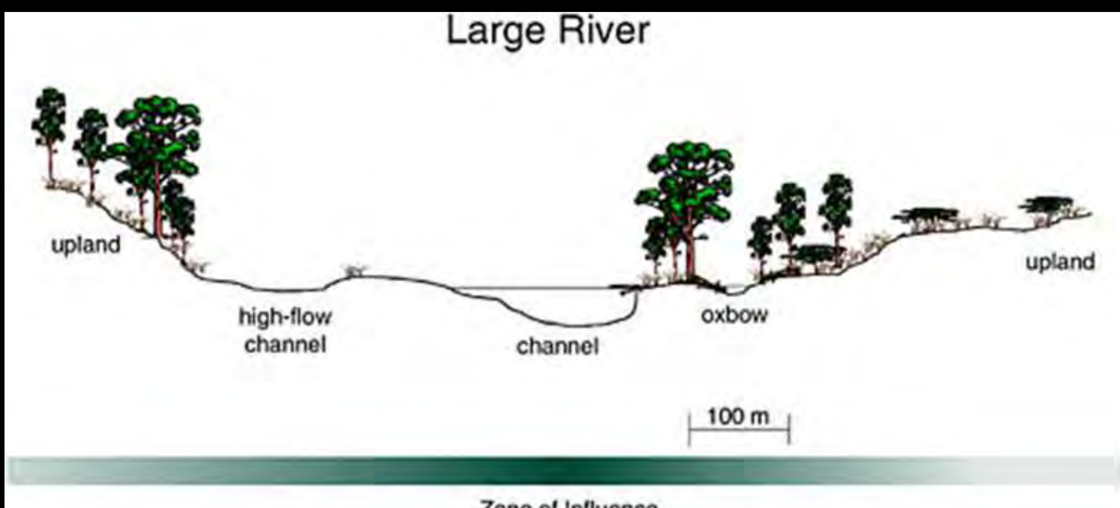
- River sources are usually <u>small</u> and, in the case of mountain streams, <u>steep</u> and <u>erosional</u>.
- In temperate and tropical environments, small streams tend to be <u>shaded by an interlocking, overhead tree canopy</u>.
- Such conditions result in <u>cool, well-oxygenated streams</u> that are abundantly supplied with <u>a food base of leaves</u>.
- Fine particles of organic matter are released as the leaves are broken down by biological communities in the streams – <u>the foundation of the aquatic foodweb</u>


Upper Course – Arid Southwest
Critical Riparian Area

The Middle Course: Life in the Meander Belt

Habitat Diversity

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

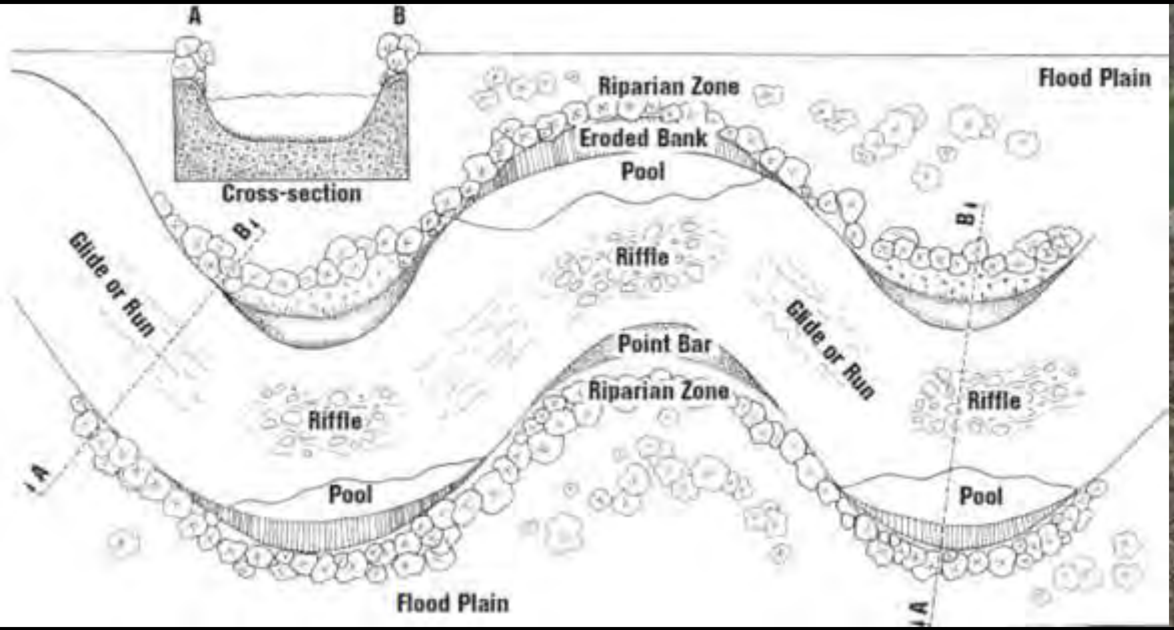


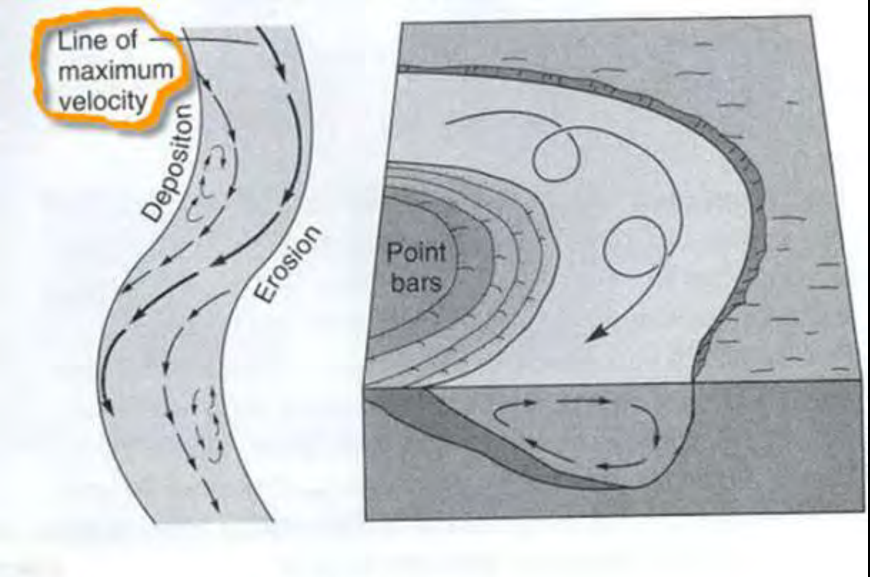
The Middle Course

Wider Channel = More Solar Energy

At some point along their path to the sea, rivers have typically gained enough water and width to preclude interlocking tree canopies.

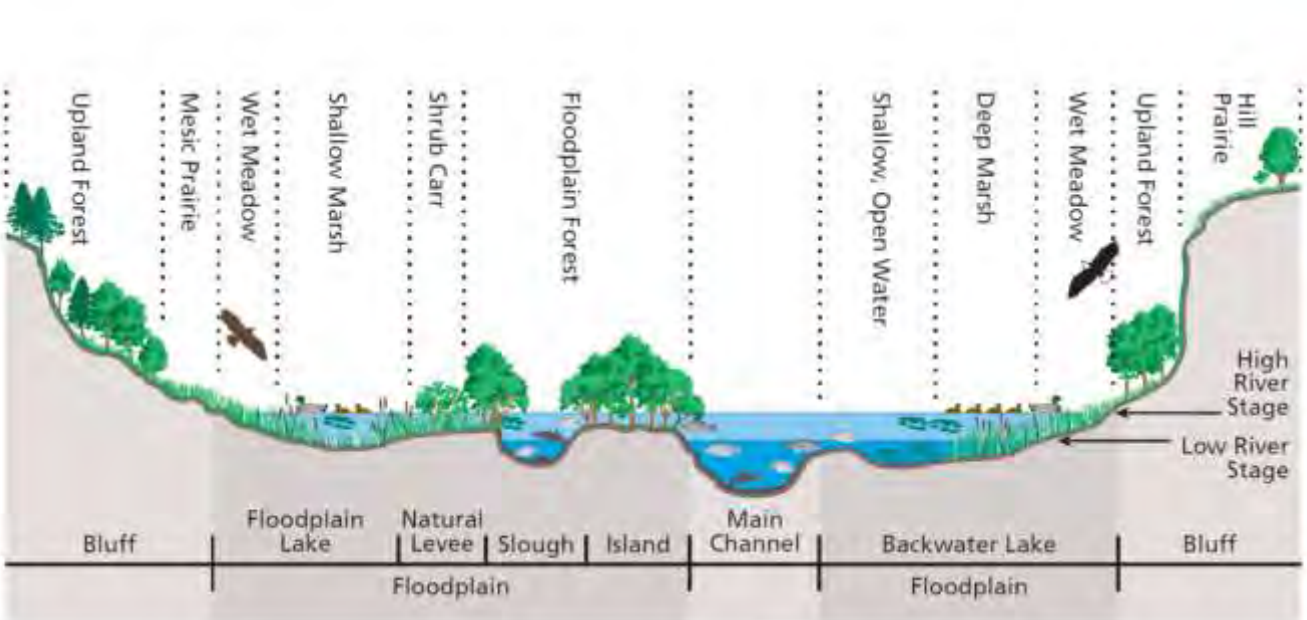
Erosional Zone and Depositional Zone

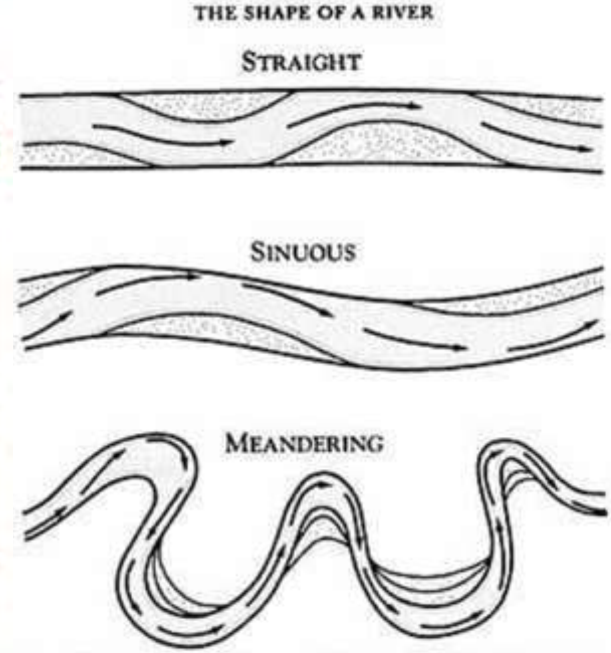


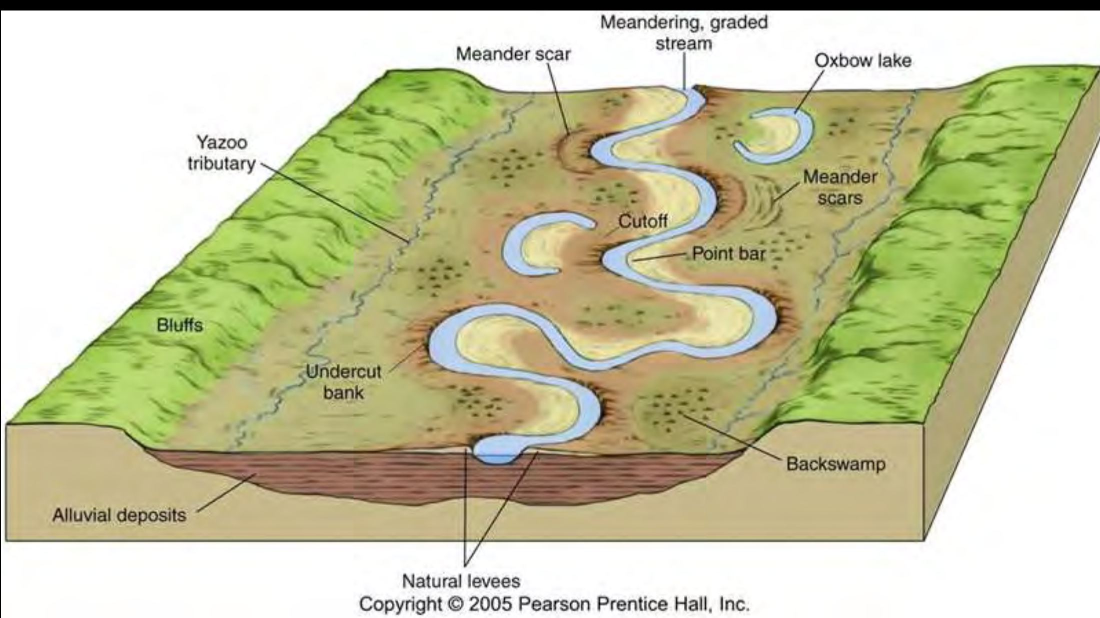


Helical flow in a meander.

The Meander Belt – Diverse and Dynamic Riparian Habitat

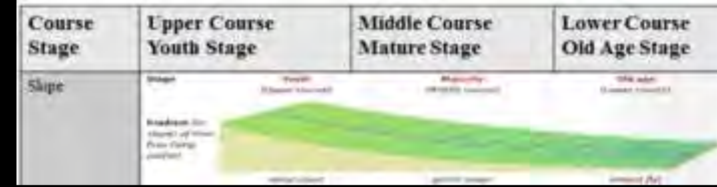






The Lower Course: From River to Sea
Old Age and Final Extinction

- Very large rivers are usually low gradient and the main channel is very wide, resulting in negligible influence of riparian canopy in terms of shading and leaf-litter input.
- Larger alluvial rivers in their natural state are diverse habitats with side channels, sand and gravel bars, and islands that are formed and reformed on a regular basis.



Riparian Vegetation

- The functionality of riparian zones is determined by a combination of erosion, deposition, hydrology and riparian vegetation.
- The factor you can most easily influence is the plant community that exists in the riparian zone.

Bank Stability = Roots

A diverse plant community is also critical to streambank stability.

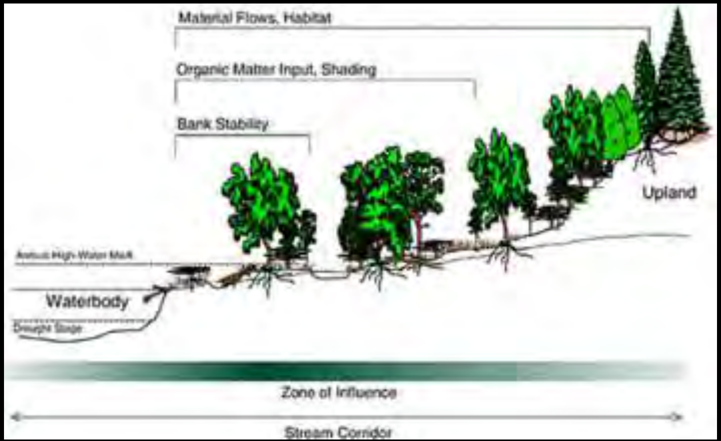
Stable streambanks usually <u>need a mix of species that include those with both fine roots and those with larger, more substantial roots</u>. In most cases, this requires a mixture of sedges or rushes, grasses and woody species.

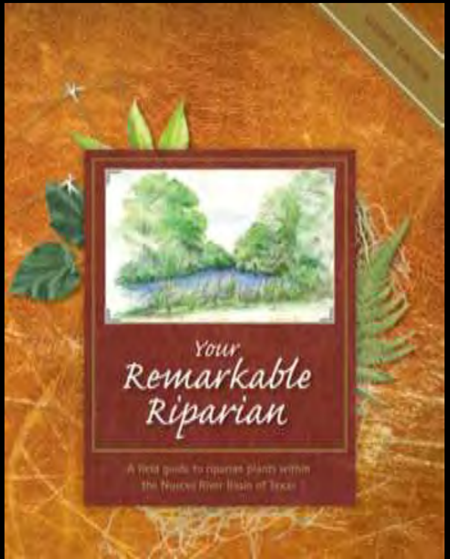
Riparian Vegetation

Plant community structured by hydrology

Hydric Soils

Different plant species, or groups of plants, support riparian zone ecosystem function.





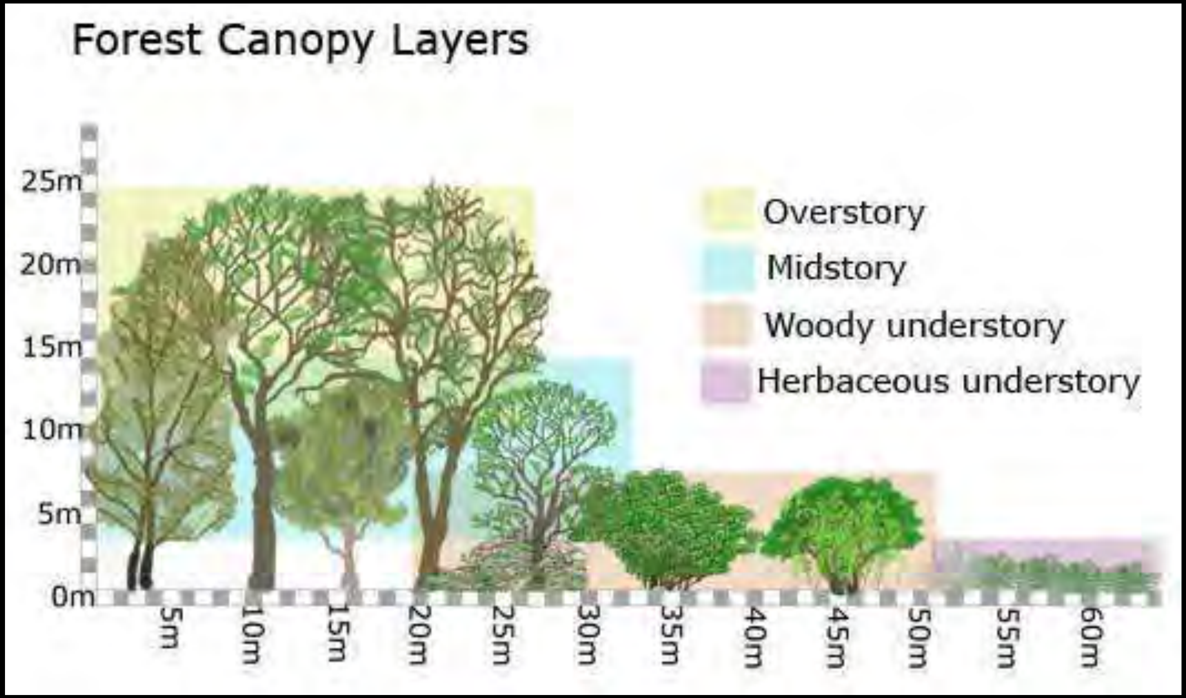
Riparian Vegetation

Riparian and Bottomland Forest

Open areas - “Bottomland prairies”

<u>Above Permanent Waterline</u>

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



Riparian and Bottomland Forest - Vertical structure

At Permanent Waterline, not saturated year-long

Elderberry	Southern wildrice (Zizaniopsis)
Buttonbush	Texas Sophora (Eve's Necklace)
Dwarf willow	Eastern Gamagrass
Sandbar willow	Switchgrass
Black willow	Horsetail
Box elder	Soft rush
Sycamore	Bulrushes
Cardinal Flower	Sedges
Roughleaf dogwood	Bushy bluestem
Bald cypress	Smartweed
Baccharis	Cattails
River Hemp [Sesbania]	Spikerushes

Permanently saturated (gravel bars)

Or in the water (wetland plants)

Bald Cypress

Southern wildrice (Zizaniopsis)

River Hemp [Sesbania]

Bulrushes

Horsetail

Soft rush

Reeds

Sedges

Cattails

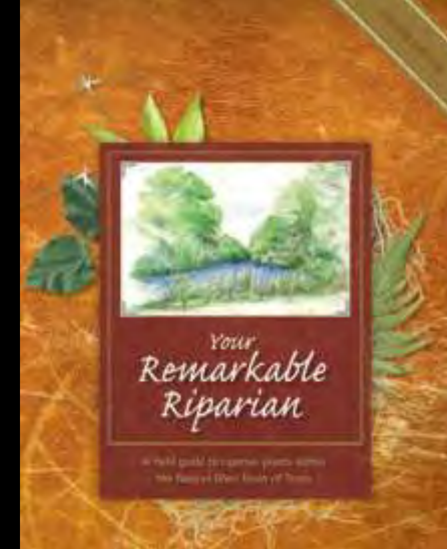
Spikerushes

Ludwigia

Riparian Process

Types of Vegetation:

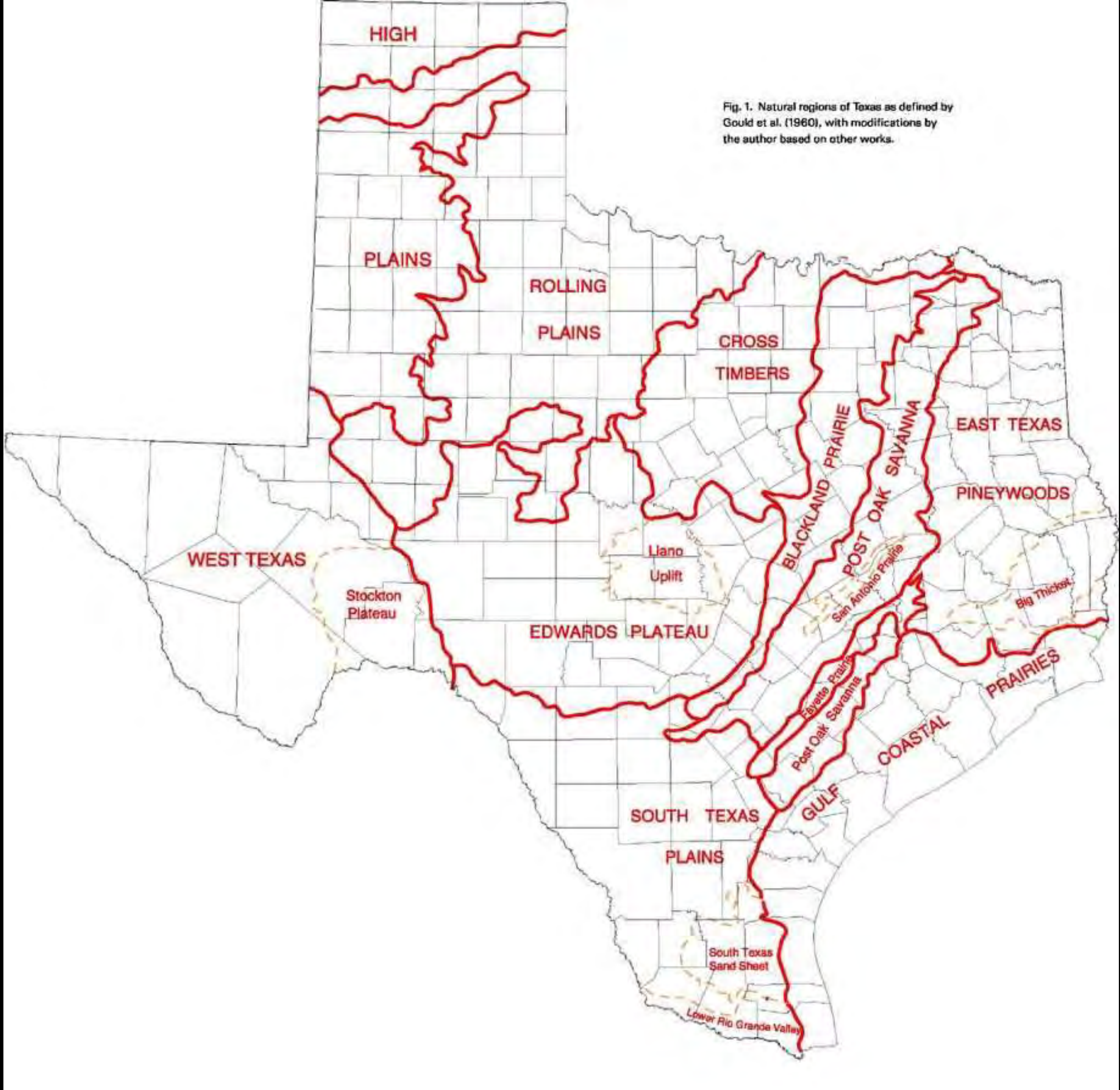
Colonizers
Stabilizers
Woody



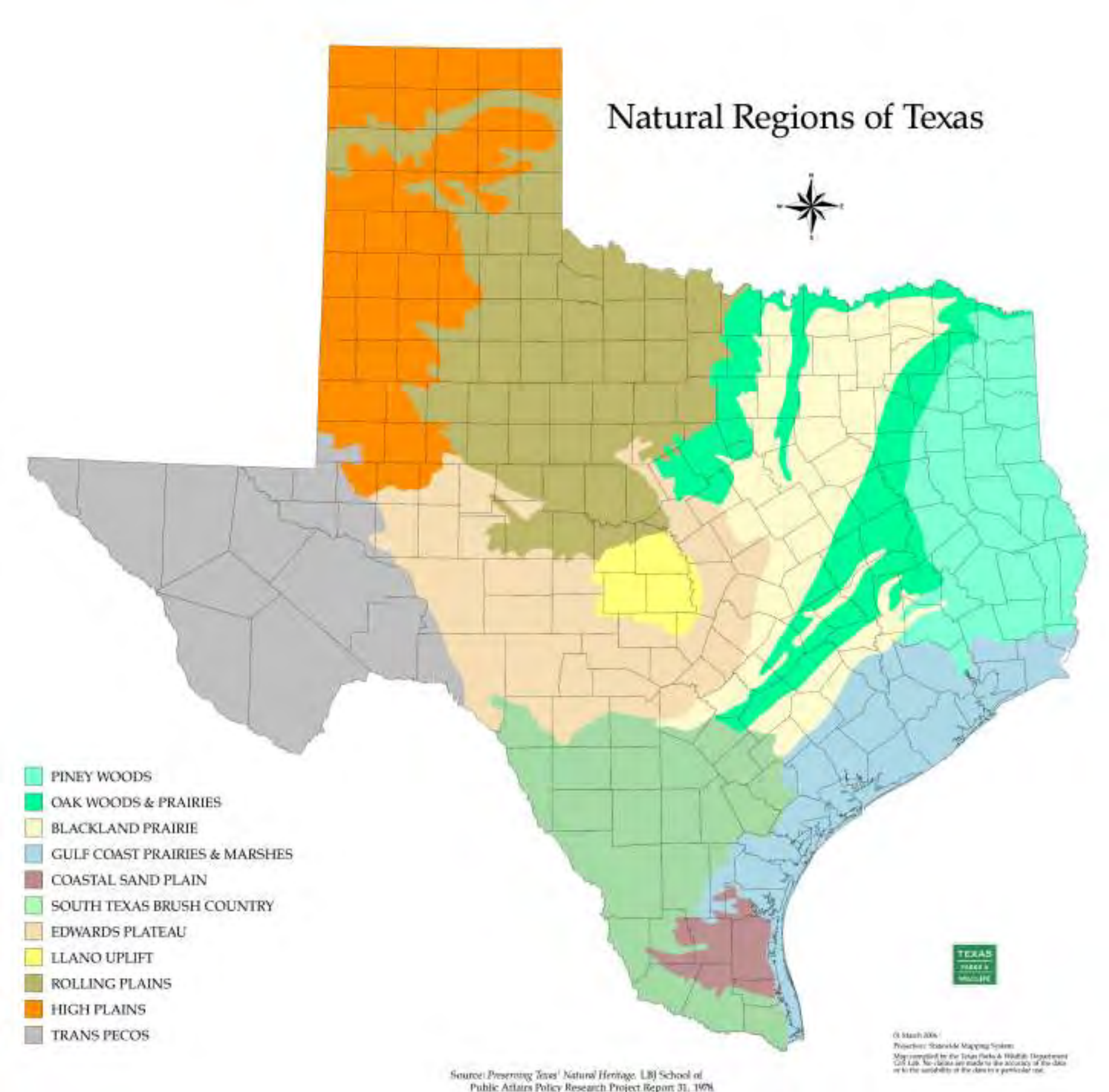
Ecosystem Process

Nonequilibrium dynamics

Texas Riparian Habitat?



Texas Riparian Habitat?



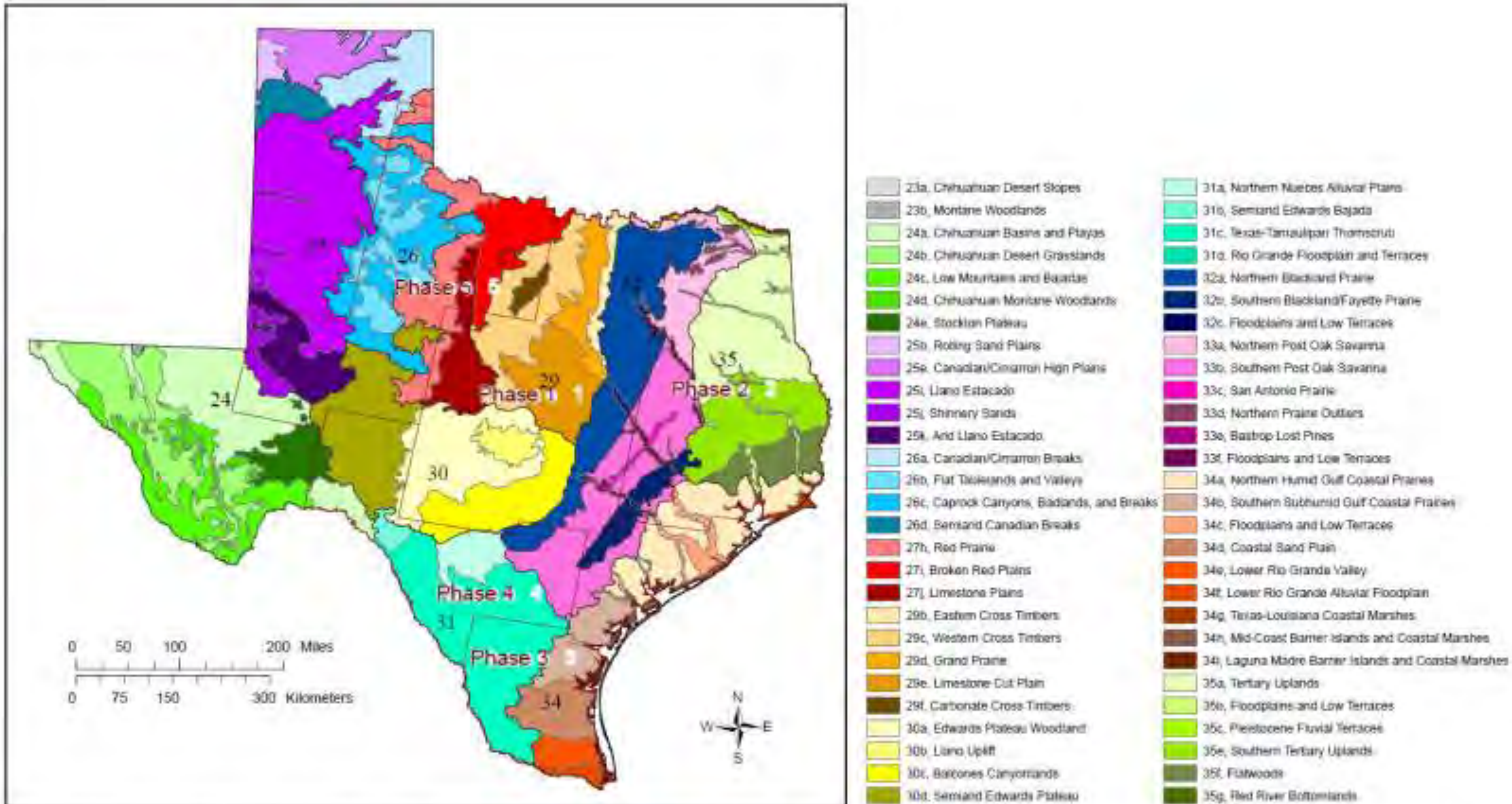


Figure 1. Texas Ecological Systems Mapping project phase map. Outlines of the phases correspond with the footprints of satellite scene data. The project will be completed in the early fall of 2012.

Contemporary Ecology of Texas - Texas Ecological Systems Project

The Texas Parks and Wildlife Department cooperated with private, state, and federal partners to produce a new land cover map for Texas, using an expansion and modification of the original NatureServe Ecological Systems Classification System.

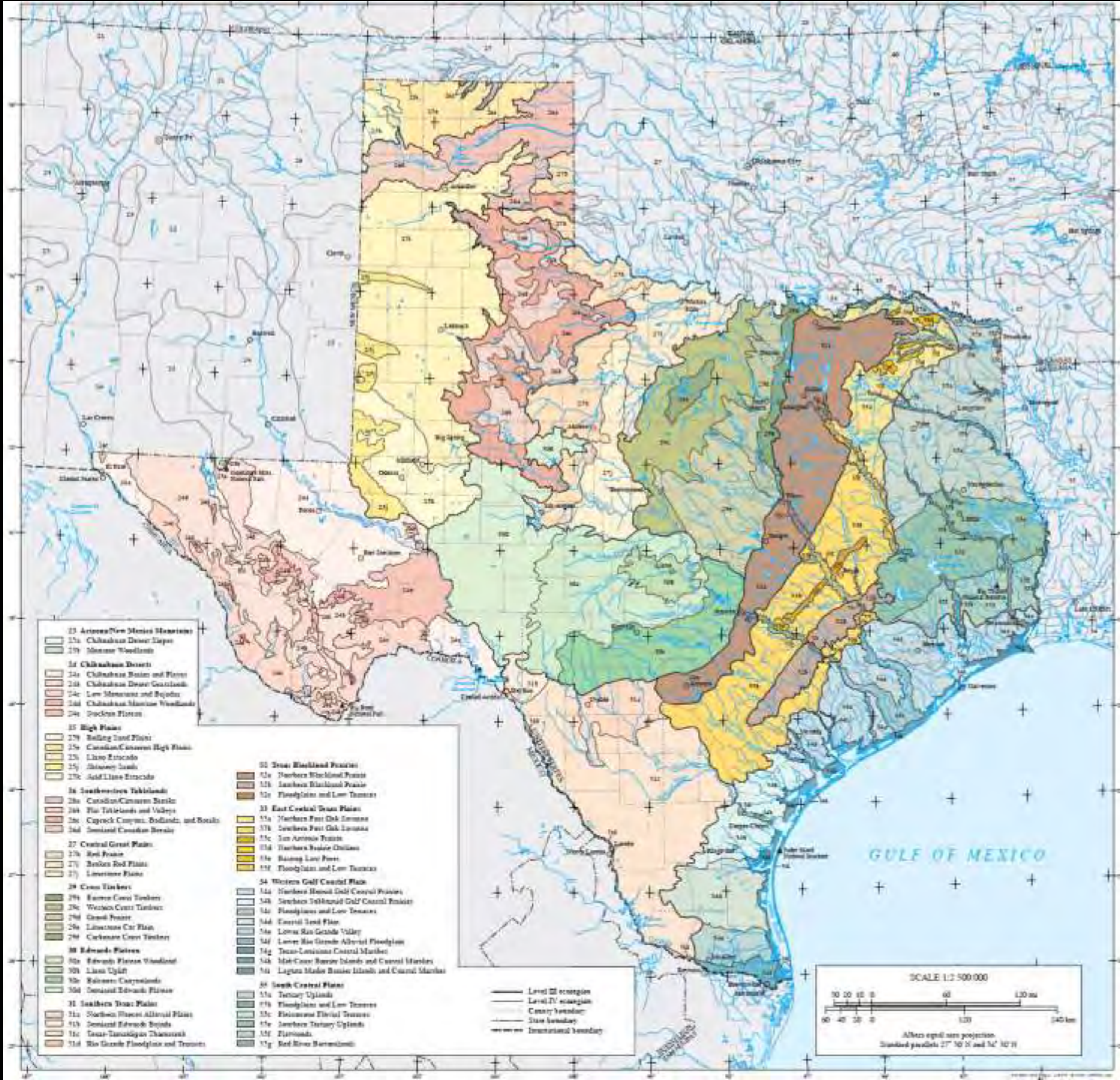
The resulting Mapping Subsystems are essentially land cover types within more broadly-defined ecological systems, which represent groups of related plant communities affected by similar processes, and occurring together within larger landscapes.

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

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


24 Chihuahuan Deserts
25 High Plains
27 Central Great Plains
27h Red Prairie
27i Broken Red Plains
27j Limestone Plains
29 Cross Timbers
29c Western Cross Timbers
29d Grand Prairie
29f Carbonate Cross Timbers
30 Edwards Plateau
30b Llano Uplift
31 Southern Texas Plains
32 Texas Blackland Prairies
32c Floodplains and Low Terraces
33 East Central Texas Plains
33f Floodplains and Low Terraces
34 Western Gulf Coastal Plain
34c Floodplains and Low Terraces
34d Coastal Sand Plain
34e Lower Rio Grande Valley
34f Lower Rio Grande Alluvial Floodplain
34g Texas-Louisiana Coastal Marshes
35 South Central Plains
35a Tertiary Uplands
35b Floodplains and Low Terraces
35e Southern Tertiary Uplands
35f Flatwoods
35g Red River Bottomlands
Level III ecoregion
Level IV ecoregion
County boundary
State boundary
International boundary
GULF OF MEXICO
SCALE 1:2 500 000
Albers equal area projection


Riparian Faunal Biodiversity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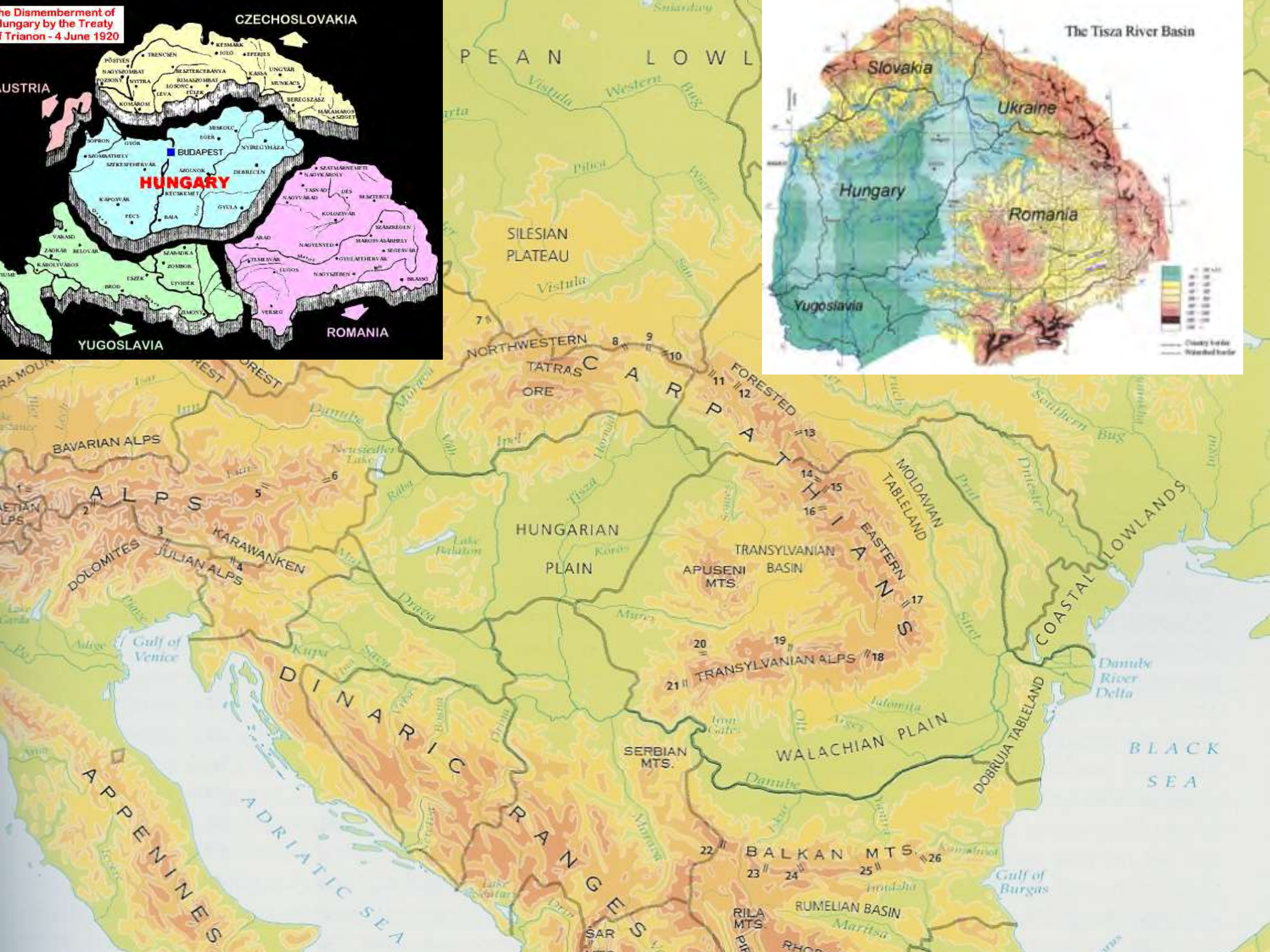
Life at the Edge in Hungary
The Tisza River

Riparia riparia
(Linnaeus, 1758)

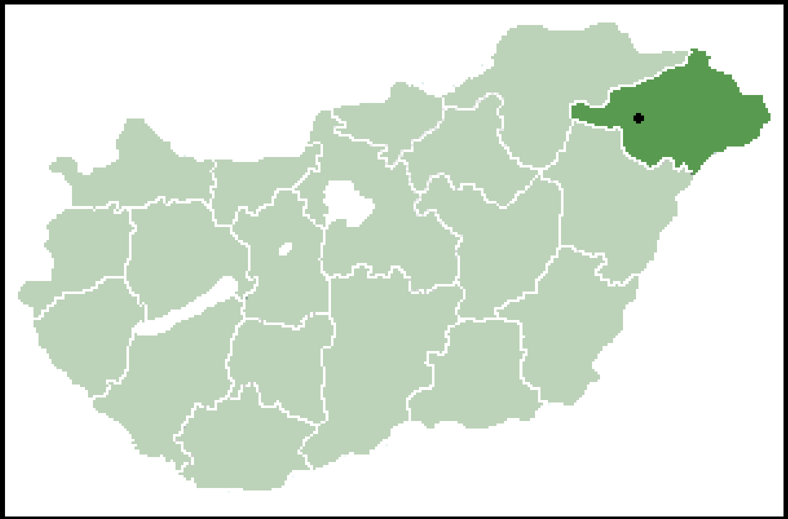
Sand Martin
Bank Swallow

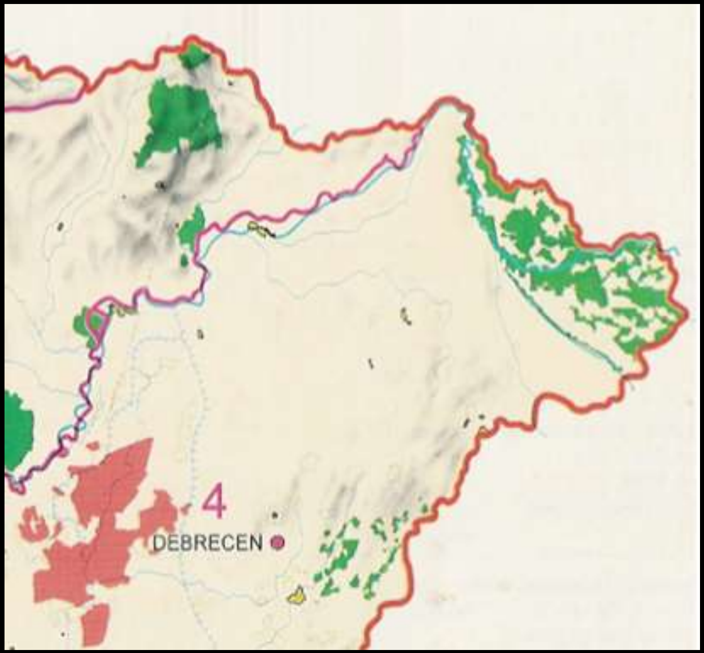
Felső-Tisza Alapítvány
Upper Tisza Foundation


PEAN LOWL
Vistula
Western Bug
Pilica
SILESIAN PLATEAU
NORTHWESTERN
TATRAS
ORE
FORESTED
CARPATHIANS
BAVARIAN ALPS
ALPS
DOLOMITES
JULIAN ALPS
KARAWANKEN
Danube
Neusiedler Lake
Lake Balaton
Tisza
HUNGARIAN PLAIN
MOLDAVIAN TABLELAND
EASTERN
TRANSYLVANIAN BASIN
APUSENI MTS.
TRANSYLVANIAN ALPS
COASTAL LOWLANDS
Southern Bug
Dniester
Prut
Gulf of Venice
DINARIC RANGES
SERBIAN MTS.
Iron Gates
WALACHIAN PLAIN
DOBRUJA TABLELAND
Danube River Delta
BLACK SEA
APPENINES
ADRIATIC SEA
BALKAN MTS.
Gulf of Burgas
RUMELIAN BASIN
RILA MTS.
SAR
he Dismemberment of
lungary by the Treaty
f Trianon - 4 June 1920
CZECHOSLOVAKIA
USTRIA
BUDAPEST
HUNGARY
ROMANIA
YUGOSLAVIA
The Tisza River Basin
Slovakia
Ukraine
Hungary
Romania
Yugoslavia


SLOVAKIA
UKRAINE
Bratislava
AUSTRIA
Lake Fertő
Sopron
Győr
Salgótarján
Bükk
Miskolc
Mátra
Eger
Nyíregyháza
Tatabánya
Tisza
Rába
Budapest
Debrecen
Szombathely
Bakony
Székesfehérvár
Veszprém
Szolnok
Zalaegerszeg
Dunaújváros
Kecskemét
Körös
SLOVENIA
Lake Balaton
Danube (Duna)
ROMANIA
Békéscsaba
Kaposvár
HUNGARY
Szekszárd
Szeged
Pécs
ELEVATION:
1 000 m
500 m
200 m
100 m
0
Drave (Drava)
SERBIA
CROATIA
0
50
100
150
200 km

The Upper Tisza Region - Szabolcs-Szatmár-Bereg County

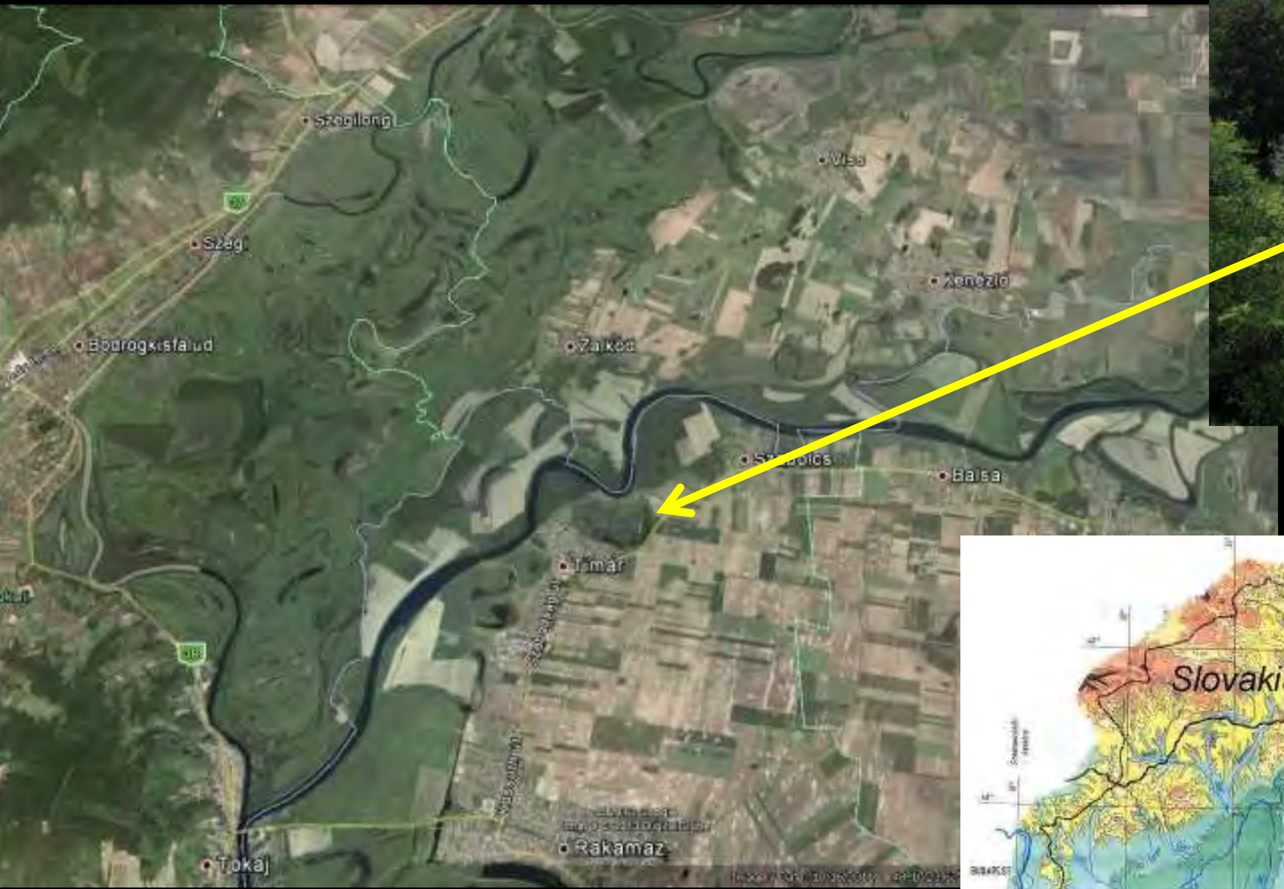


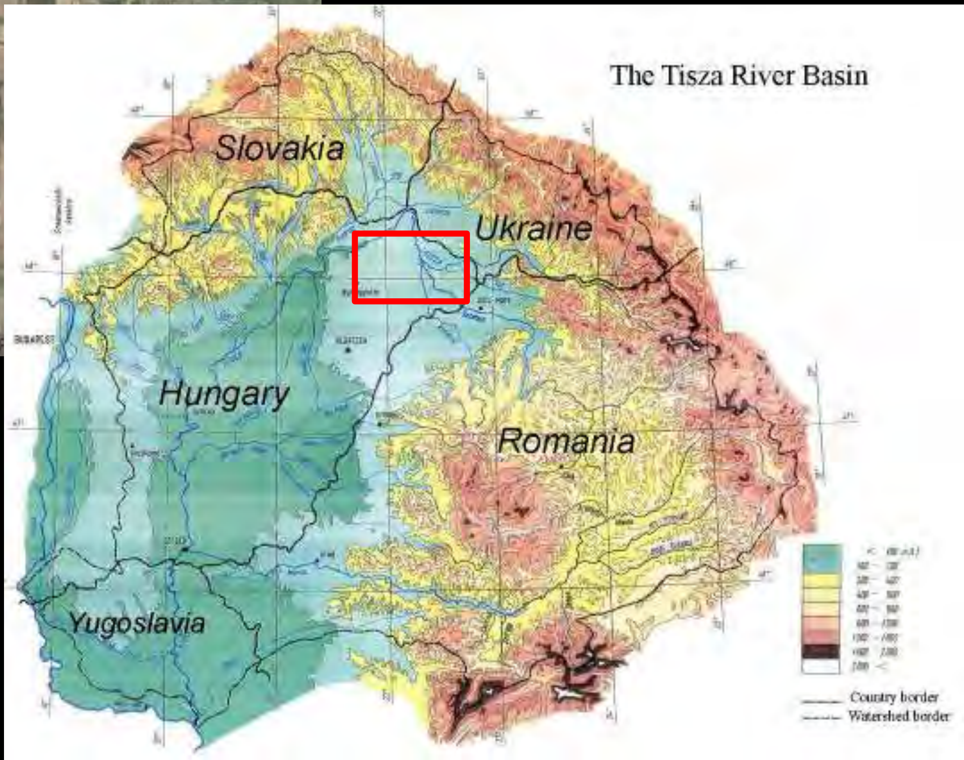


Green – Nature “Protected” Areas

Red – Hortobagy National Park

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.

Upper Tisza River

Riparian Habitat

Hungary 1

1990-1992

Imre Vass

Largest *Riparia riparia* Breeding Colonies in Europe

Dr. Tibor Szép


Szép T.(c)





THINKING GLOBALLY

THE PEACE CORPS JOINS IN

Can teaching English help the upper Tisza?

by Judy Braus

When it first flows into Hungary from the Soviet Union, the Tisza River is relatively clean—especially when compared to its infamous neighbor, the Danube. But before long the water quality of the Tisza begins to plummet.

The Szamos and Kraszna rivers, flowing from Romania, dump heavy metals, phosphates, and other pollutants into the Tisza as it makes its way south. At Tokaj, near the lower end of the Upper Tisza, the Bodrog River, flowing from Czechoslovakia, dumps more tainted water. And along its 600-kilometer path through Hungary, the Tisza relentlessly receives in-country pollution, including waste and run-off from chemical factories, power plants, and agricultural fields.

Pollution of the Tisza River is just one example of many serious environmental problems facing Hungary. Like the rest of Central Europe, the country suffers from acid rain, smog, hazardous waste disposal, habitat destruction, and other environmental problems. But there is a bright spot in the doom and gloom of the pollution and degradation. Armed with enthusiasm and innovative ideas and backed by an agency-wide commitment to environmental education, U.S. Peace Corps volunteers have begun tackling environmental problems at the grass roots level, working in camps, schools, and communities across Hungary.

An environmental education workshop conducted in the dead of winter in a small town near the Czechoslovakian border gave many volunteers their first opportunity to get involved with Hungary's environmental problems. During the workshop, more than 60 volunteers working as English teachers and their Hungarian colleagues took part in sessions focusing on air and water pollution, solid waste, and natural resource issues—as well as on teaching strategies for incorporating environmental education into their English teaching lesson plans. They also studied strategies for motivating students to get involved in local environmental issues and for helping students develop lifelong problem-solving skills.

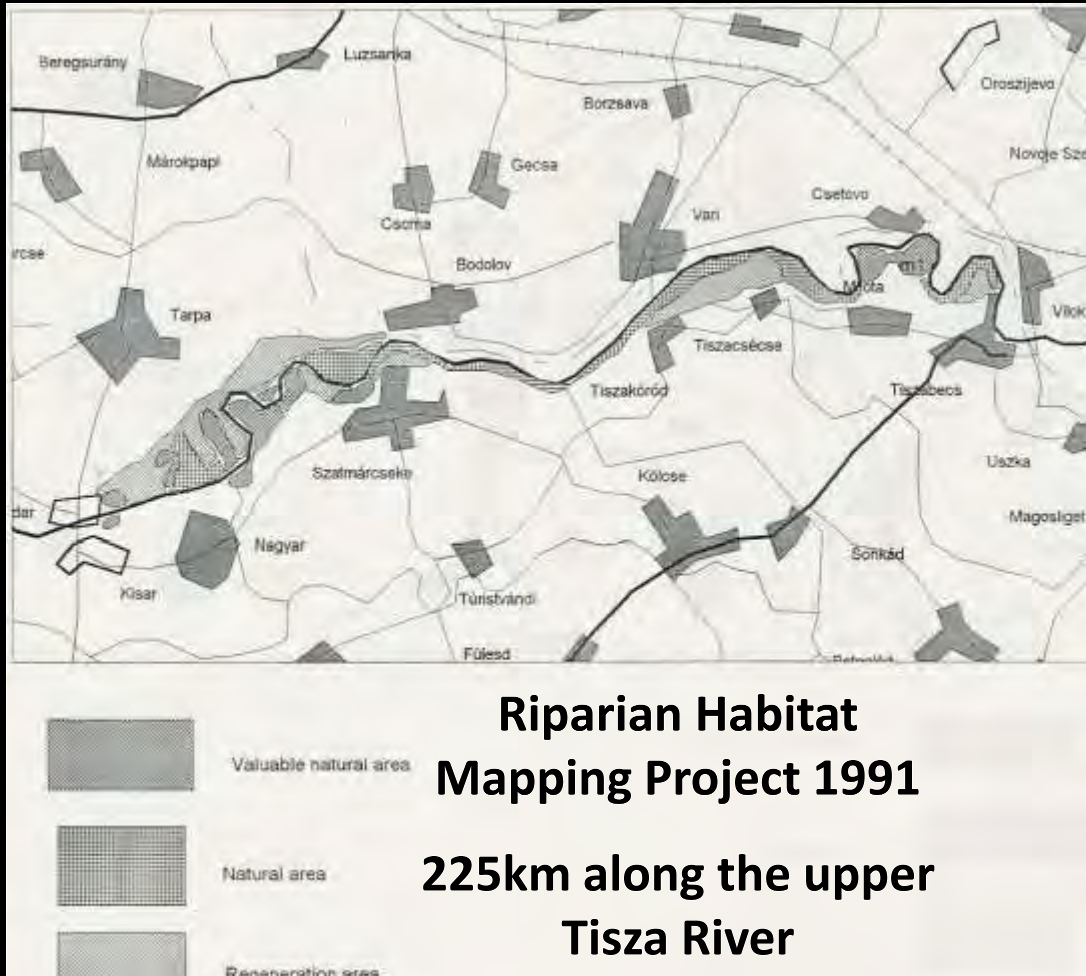
As a result of the workshop, many of the volunteers immediately began incorporating environmental topics into their daily lesson plans. During site visits, Kathryn Rulon, Associate Peace Corps Director for Education, found that volunteers were successfully using environmental content to teach English, encouraging student creativity, and empowering students to make a difference: "I couldn't believe how many of the volunteers were creatively adapting environmental content to match the interests and concerns of their students. I'd walk into classrooms and the students would be debating energy issues, writing environmental poetry, or performing pollution raps. Environmental education and English teaching are a natural fit!"

Several volunteers also took the activities and lesson plans developed during the workshop to camp. They

On assignment in Hungary, Peace Corps volunteers teach English and environmental literacy at the same time.

As for the problems in the upper Tisza River, one Peace Corps volunteer, Kevin Anderson, channeled his concern into a concrete proposal for action. Before the workshop, Kevin had been working with the Nyireghyaza Chapter of the Hungarian Ornithological and Nature Protection Society to band sand martins and also to organize a summer environmental camp. Through his work, he discovered that the Upper Tisza not only supports the largest colony of sand martins in Europe, but it is also rich in forest and wetland habitats that provide homes to some of the most diverse wildlife in the country. He realized that a public awareness campaign would be important, given that many of his neighbors in the rural town of Nyireghyaza consider the area an undeveloped "wasteland" that would be more useful if it were developed.

PEACE CORPS



Riparian Habitat Mapping Project 1991

225km along the upper Tisza River

Felső-Tisza Alapítvány
Upper Tisza Foundation

PEACE CORPS

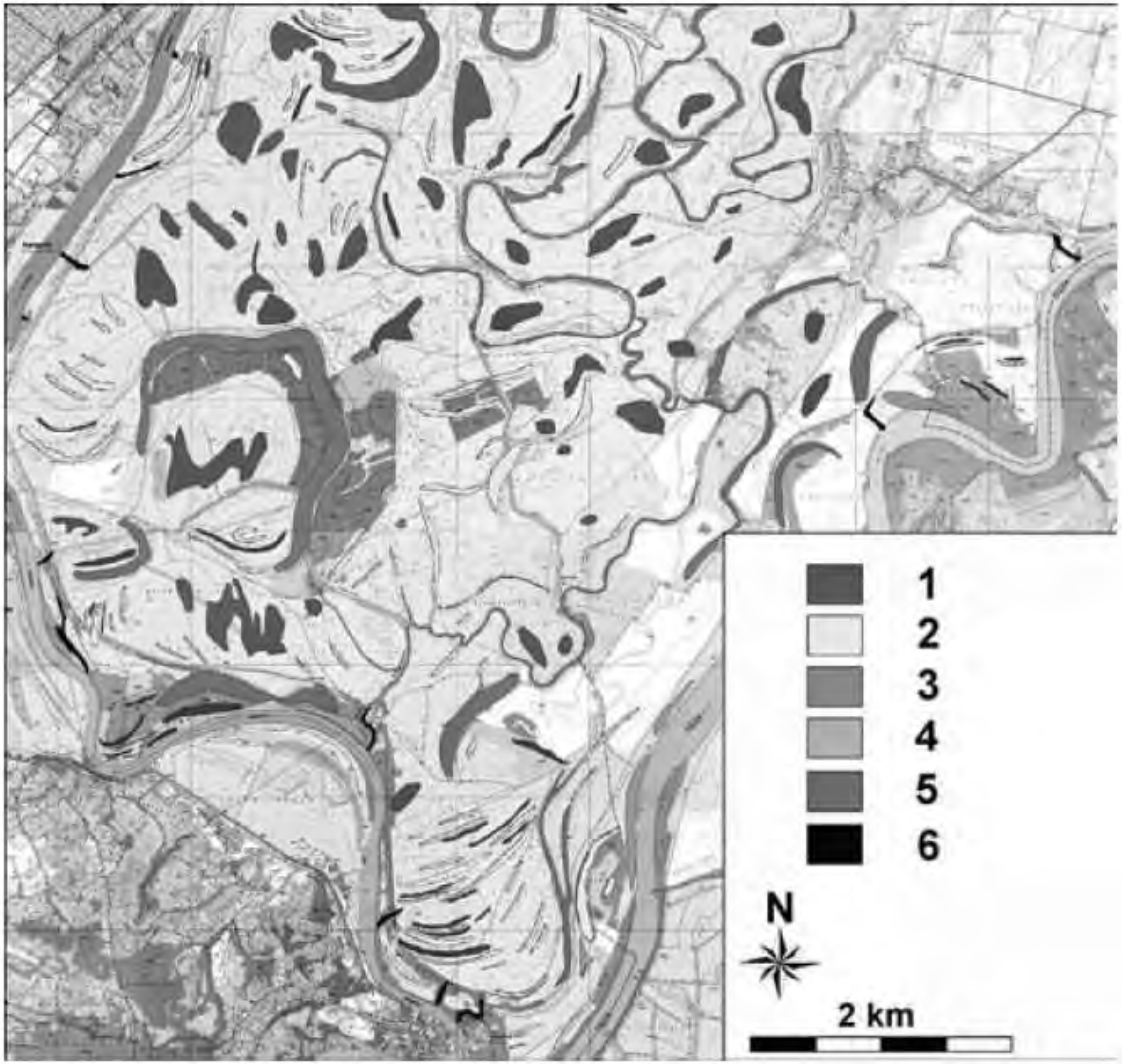
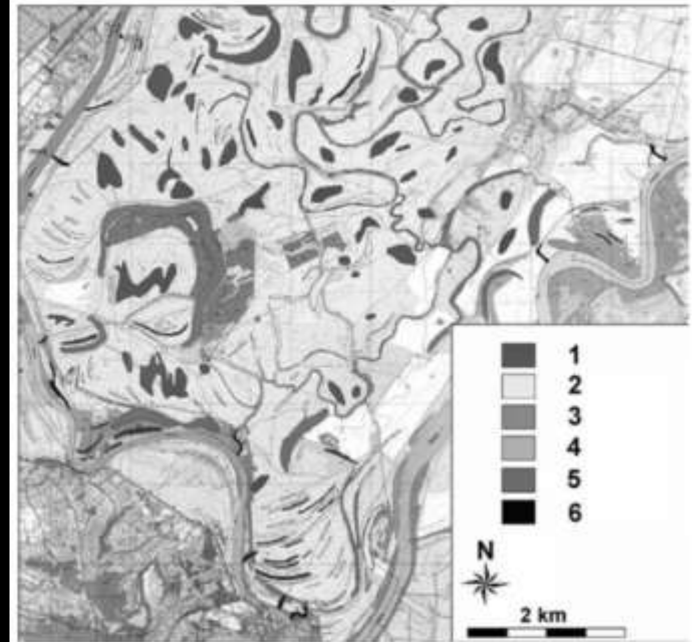


FIG. 2 - Landforms of the SW Bodrogköz (In: Szabó & *alii*, 2004). 1: fluvial ridge, 2: swale, 3: abandoned cut-offs, 4: present natural levee, 5: backswamps, 6: (remnants of) one-time flood-plain ditches.



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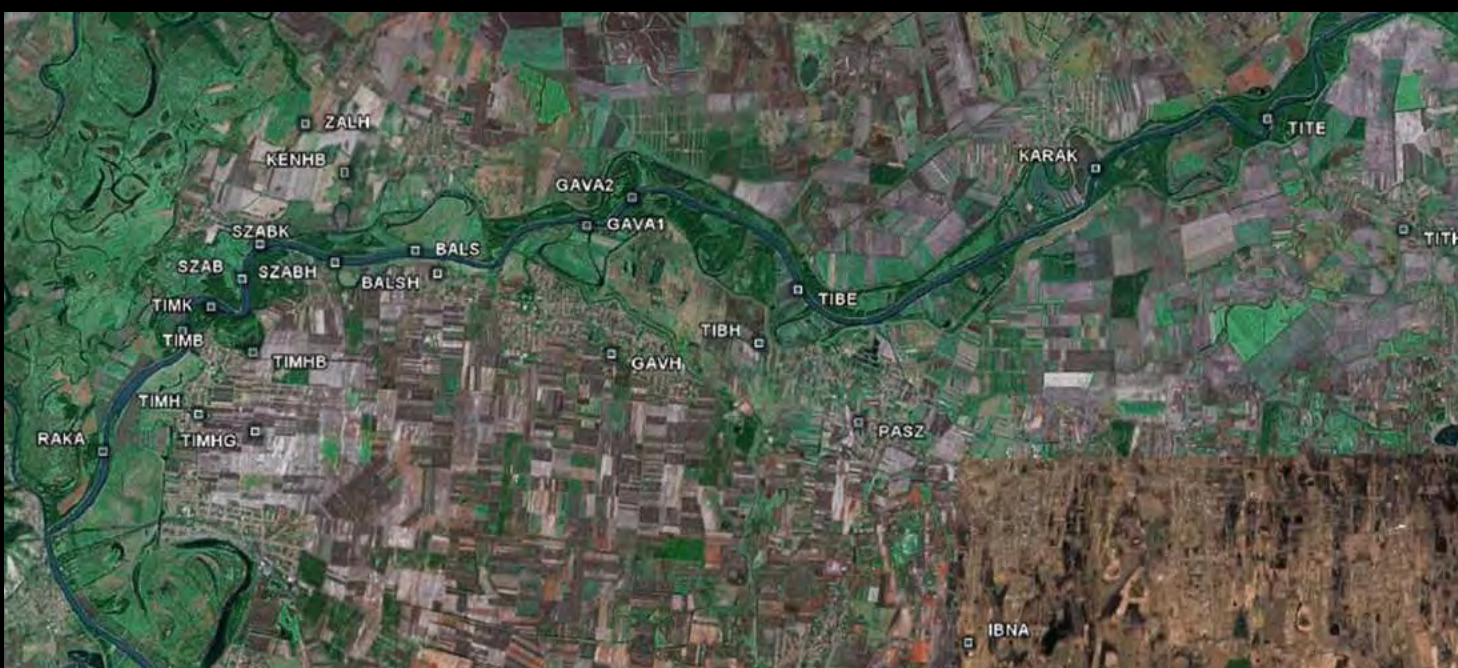


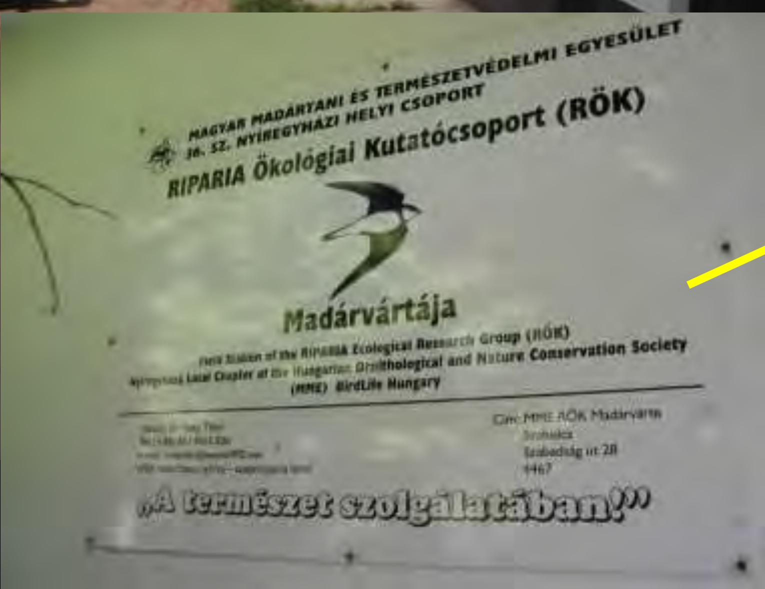
The Upper Tisza River in northeastern Hungary.

Now a cross-border UN Ramsar Wetland of International Importance

Tisza River Ecological Research Center

Established 2002

Szabolcs, Hungary



Felső-Tisza Alapítvány

Upper Tisza Foundation

Upper Tisza Foundation

Felső-Tisza Alapítvány


RIP

Life at the Edge

Riparia riparia
(Linnaeus, 1758)

Sand Martin
Bank Swallow

Felső-Tisza Alapítvány
Upper Tisza Foundation

Riparian Zone = Waterway Margins

Proper Functioning Condition

- dissipate stream energy
- improving water quality and quantity
- filter sediment
- capture bedload
- aid in floodplain development
- improve flood-water retention
- improve groundwater recharge
- stabilize streambanks
- store water
- provide habitat
- support greater biodiversity