

Ecosystem Benefits of Ashe Juniper Pioneer Thickets and Old- Growth Cover

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Overview

Key Differences

Regional Preference

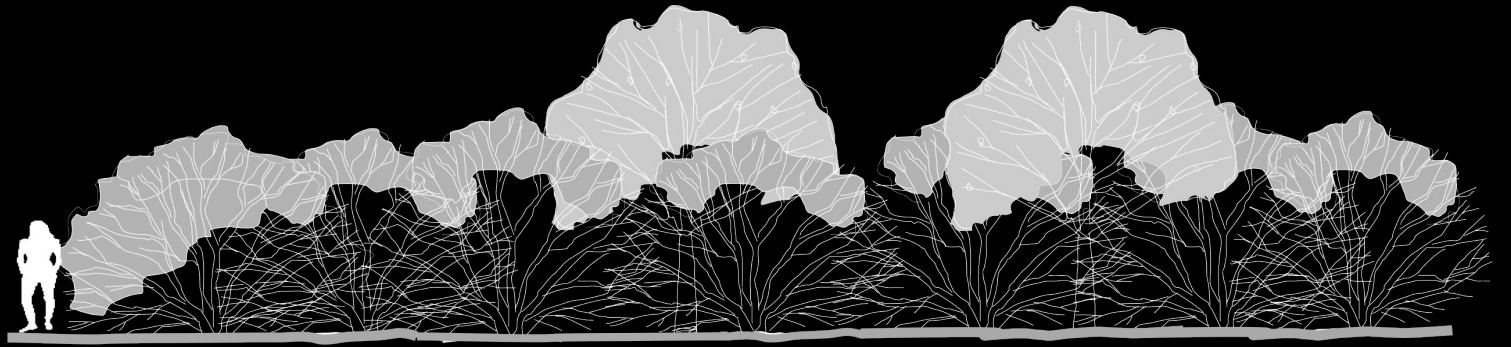
Ecosystem Benefits

Closing Comments

Basic Differences

Pioneer Thicket

Shorter - less diverse
< 30-40 years old



10-25' tall

Old-Growth Cover

Taller - more diverse
200-250+ years old



25-80' tall

Pioneer Thicket

represents early
ecological succession

Old-Growth Cover

represents late
ecological succession



Pioneer Thicket

Indicates degraded soil



Old-Growth Cover

Sustains healthy soils

Pioneer Thicket

Historically, uncommon

Reports describing eastern Edwards Plateau vegetation from mid-1700 to the 1800s:

The words “forest” and “timber” used to describe the junipers (cedars)

When “thicket” was used, it was also called “timber” or “stately”



Old-Growth Cover

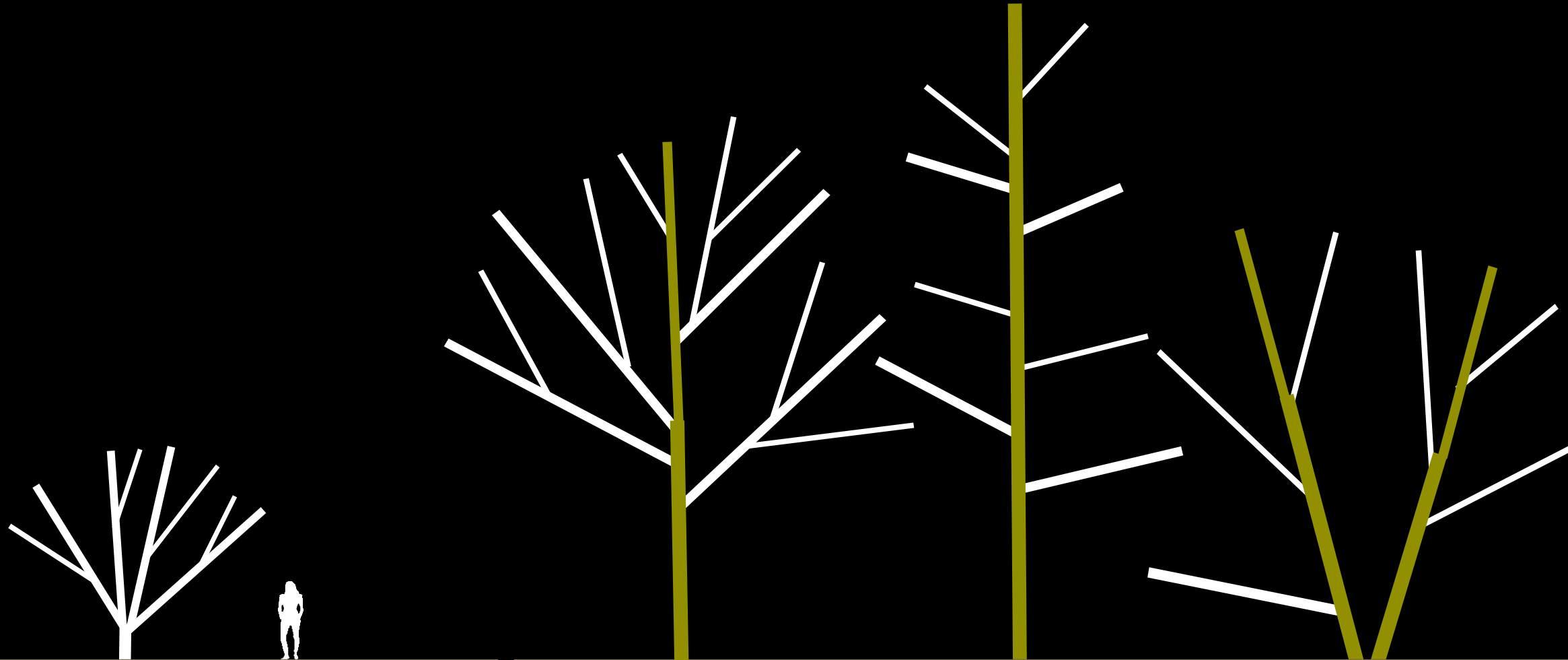
Historically, common

Pioneer Thicket

Defined by bushes

Old-Growth Cover

Defined by trees



oak-like

pine-like

multi-trunk

Pine-like



Oak-like





Multi-trunk



**Juvenile
Trees**



Aging Junipers

**Helps determine
age of cover**

Aging using growth
rings can be difficult since
junipers produce false
growth rings



Fruits and pollen
10-20+ years



*Cyanospora
albicedrae*

Trunk Lichen: 5 - 40 years



Loose Bark: 40-50+ years

Age can be estimated by measuring the trunk width 4.5' from the ground (dbh)

trunk dbh (inches)/growth rate

growth rate = .1 and .06
provides age range



31.5" dbh =
315-525 yrs.

Hatfield, Jeff S. and William A. Link, 2016. *Growth Rates of Trees, and Age of Ashe Juniper, in Golden-cheeked Warbler Habitat at Balcones Canyonlands National Wildlife Refuge*. USGS Patuxent Wildlife Research Center: Maryland. <http://biodiversityworks.org/wp-content/uploads/2016/02/Hatfield-Link.pdf>, accessed December 2020.

Pulich, Warren .M. 1976. *The Golden-cheeked Warbler: A Bioecological Study*, Texas Parks & Wildlife Department: Austin.

Where the Trees Grow



Bottomland Mixed Forest

David D. Diamond, 1997. A Old-Growth Definition for Western Juniper Woodlands: Texas Ashe Juniper Dominated or Codominated Communities. USDA, Southern Res. Station.



Bottomland & Bluff Cedar Brake



Hillside Dryland Forest

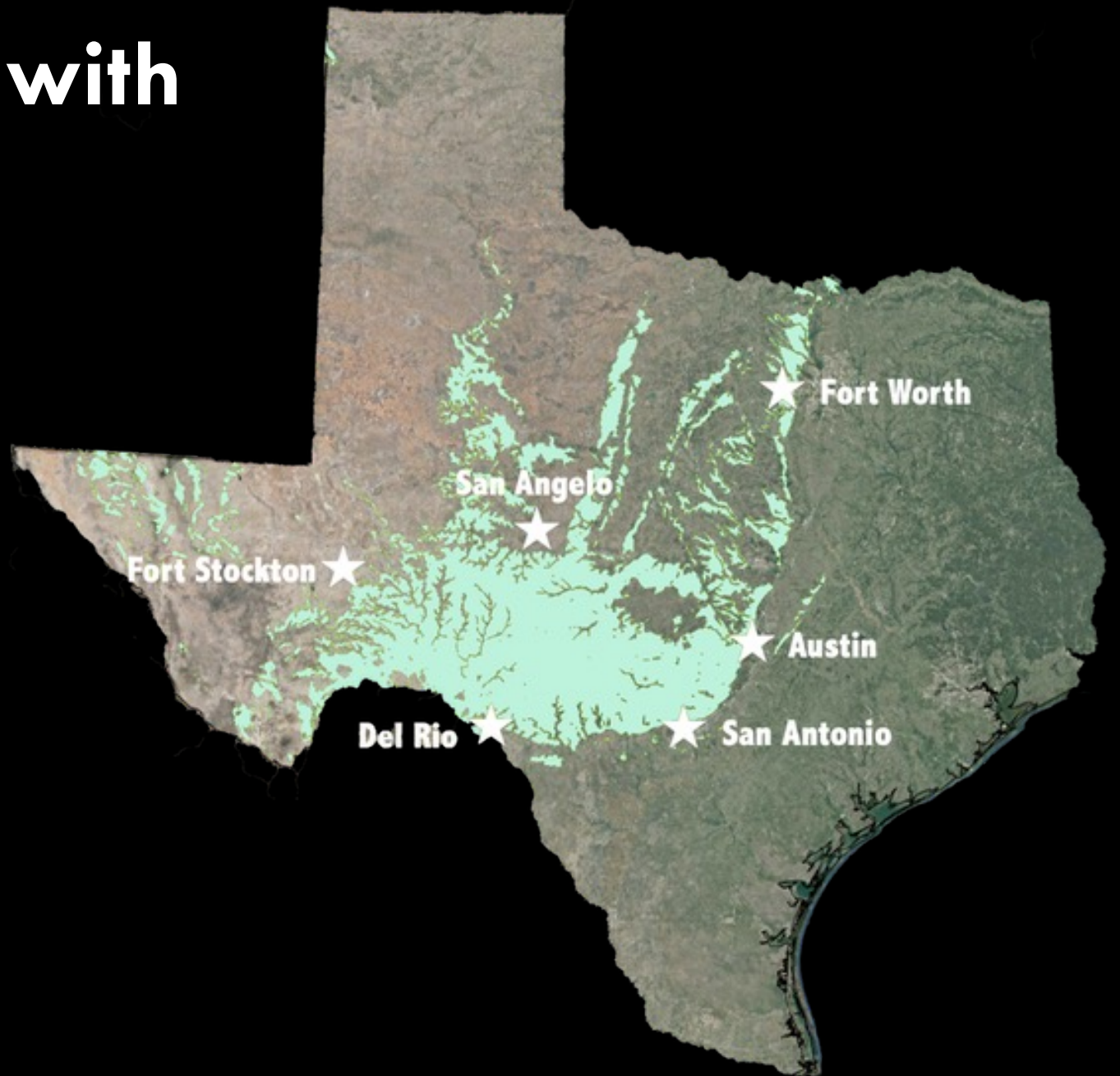


Prairie Motte and Woodland

Regional Preference

They Prefer Regions with Carbonate Rock

Most carbonate rock in
Texas is limestone



<https://karstwaters.org/educational-resources/what-is-karst/>

Veni, George, and Nico Hauwert, 2015. "Historical Review and Forward View of Cave and Karst Research in Texas," The Geological Society of America. Special Paper 516.

This type of region is called karst country

limestone bedrock + shallow soils





Characterized by rocky surface features and holy rocks





Photos by Ethan Perrine

**Underlaid by sinkholes,
caves, and aquifers**

The upper karst variability affects water use



Water research now focuses on stands, not individual trees

Stand water use of junipers = oaks

Hauwert, Nico M. and Jack M. Sharp, 2014. "Measuring Autogenic Recharge over a Karst Aquifer Utilizing Eddy Covariance Evapotranspiration," *Journal of Water Resource and Protection*. Volume 6:869-879.

Litvak, M.E., S. Schwinning, and J.L. Heilman, 2010. "Woody Plant Rooting Depth and Ecosystem Function of Savannas: A Case Study from the Edwards Plateau Karst, Texas, USA.," *Ecosystem Function in Global Savannas: Measurement and Modeling at Landscape to Global Scales*, eds. M.J. Hill and N.P. Hanan. CRC Press: Boca Raton.

Karst country soils are fragile

Most are very shallow

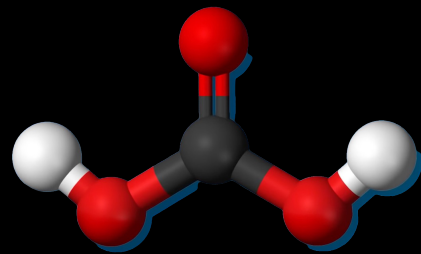
The underlying limestone means it
takes 10 - 40x longer to rebuild

Focusing on juniper removal
exposes these soils and can
push the land towards rocky
desertification

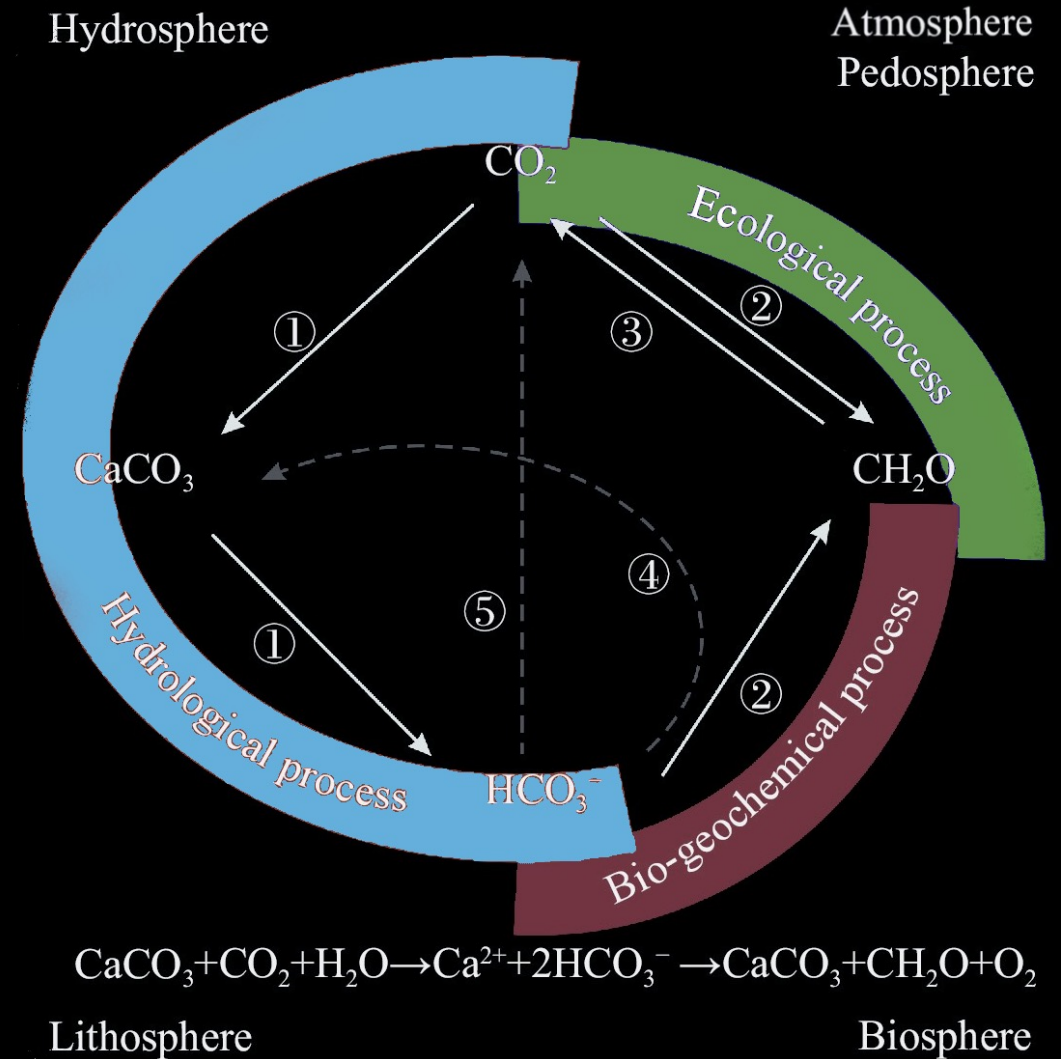


Karst Country is Part of the Carbon Cycle

Vegetation, soil, and microbes are critical for sustaining healthy karst function



carbonic acid (H_2CO_3)





**Old-growth forests help sink more
carbon than healthy grasslands**

Healthy vegetation cover sinks more
carbon than degraded cover

**This is the real problem:
Texas karst country has been repeatedly clearcut,
burned, and overgrazed since the mid-1800s**



Much of it remains degraded

<2 % soil carbon





**Native grasses have
difficulty establishing
a dense cover where
it's degraded**

Pioneer thickets can help
rangeland grasses if given the
time and proper management

Ecosystem Benefits

Pioneer Thicket

Short-term Regeneration (10 - 75 years)

Helps regenerate forest and improve grassland conditions

Old-Growth Cover

Long-term Sustainability (100s of years)

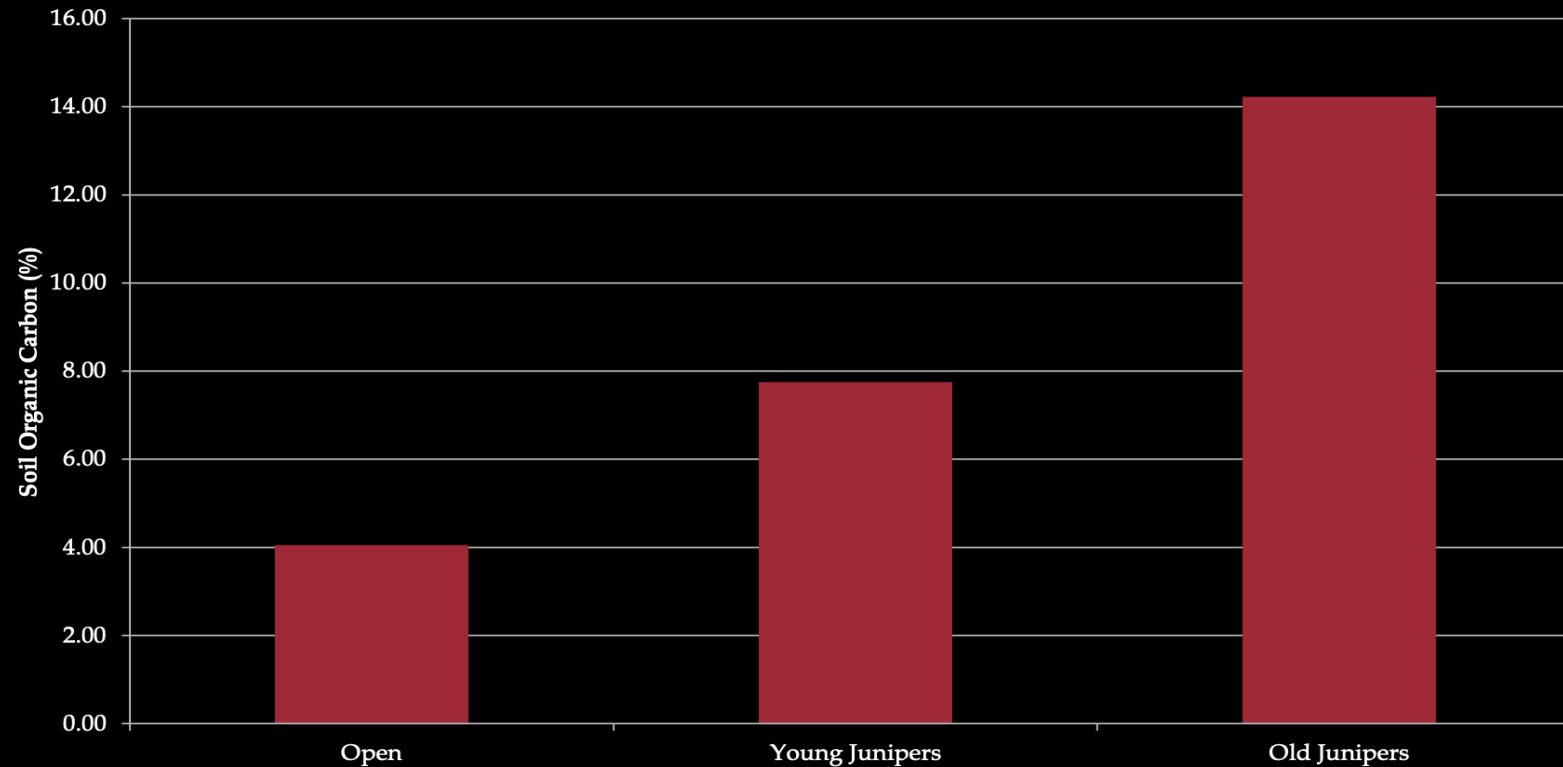
Sustains biodiversity and groundwaters,
and mitigates erosion, flooding and fire risk

Pioneer Thicket

Restores the karst carbon cycle

Old-Growth Cover

Sustains the karst carbon cycle



Balcones Canyonlands
Preserve SOC study

Levels of soil organic carbon increase with increasing woodland stand age

Pioneer Thicket

They may not be pretty, but...

- They spread fast and prolifically
 - They cover the ground
 - They improve stormflows
 - They help rebuild limestone soil
- They act as a nursery for new plants
 - They increase karst porosity

**Their dense
canopies buffer
the ground from
hard rains, hot
sun, and high
winds**



**Pioneer thickets
shed a large
amount of
slightly acidic
organic matter
year-round**



The debris and canopies slow and sink heavy rains



**Overtime, this
organic matter
builds up into a
matted leaf litter
that eventually
develops into a
loose litter**



**Under the leaf
litter, they
enhance the
growth of
arbuscular
mycorrhizal
fungi**



Photo by Lisa O'Donnell



**They end up
increasing soil
infiltration and
groundwater
storage capacity**

**3x more rain
infiltrates under karst
country junipers than
adjacent grass**

**20x more groundwater
moves through limestone
under junipers than under
nearby grass**

Leite, Pedro, et al., 2020. "Woody Plant Encroachment Enhances Soil Infiltrability of a Semiarid Karst Savanna," *Environmental Research Communications* 2 115005.

Leite, Pedro, L. Schmidt, D. Rempe, H. Olariu, J. Walker, K. McInnes, and B. Wilcox, 2023. "Woody Plant Encroachment Modifies Carbonate Bedrock: Field Evidence for Enhanced Weathering and Permeability," *Scientific Reports*. 1315431.

Wilcox, Bradford P. and Yun Huang, 2010. "Woody Plant Encroachment Paradox: Rivers Rebound as Degraded Grasslands Convert to Woodlands," *Geophysical Research Letters*. Volume 37, doi:10.1029/2009GL041929.

Enhancing infiltration increases aquifer recharge

On the eastern Edwards
Plateau, 28-30% of aquifer
recharge comes from
infiltration



Dugas, W.A., et. al, 1998. "Effect of removal of *Juniperus Ashei* on Evapotranspiration and Runoff in the Seco Creek Watershed," *Water Resources Research*. 34(6): 1499-1506.

Hauwert, Nico M. and Jack M. Sharp, 2014. "Measuring Autogenic Recharge over a Karst Aquifer Utilizing Eddy Covariance Evapotranspiration," *Journal of Water Resource and Protection*. Volume 6:869-879.

Why clearing might increase spring flows

After juniper clearing, good infiltration remains

Springs increase

After 3-5 years, infiltration degrades

Springs decrease

Dugas, W.A., et. al, 1998. "Effect of removal of *Juniperus Ashei* on Evapotranspiration and Runoff in the Seco Creek Watershed," *Water Resources Research*. 34(6): 1499-1506.

Dammeyer, Heather Cardella, Susanne Schwinning, Benjamin F. Schwartz, and Georgiane Moore, 2016. "Effects of Juniper Removal and Rainfall Variation on Tree Transpiration in a Semi-Arid Karst: Evidence of Complex Water Storage Dynamics," *Hydrological Processes*. Volume 30: 4568-4581.



**Pioneer thickets
also act as a
nursery for new
native plants**



Photo by Elenore Goode



Old-Growth Cover

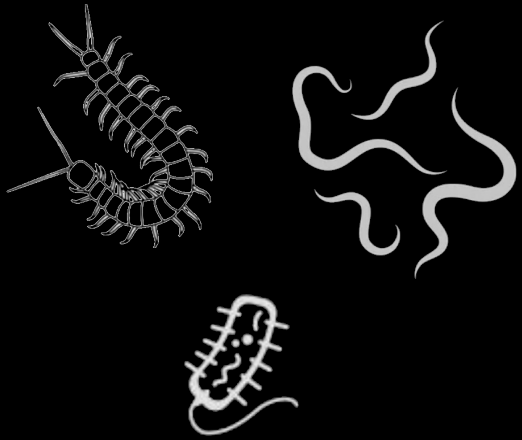
A photograph of an old-growth forest. The scene is dominated by gnarled, weathered tree trunks and branches, many of which are covered in moss and lichen. The ground is rocky and uneven, with patches of green vegetation and fallen branches. The lighting is dappled, suggesting a dense canopy above. The overall atmosphere is one of a well-preserved, ancient woodland.

- Maintains healthy soils
 - Manages stormflows
 - Supports wildlife diversity
- Sustains year-round gravity spring flows
 - Reduces wildfire risk
 - Sustains the karst carbon cycle

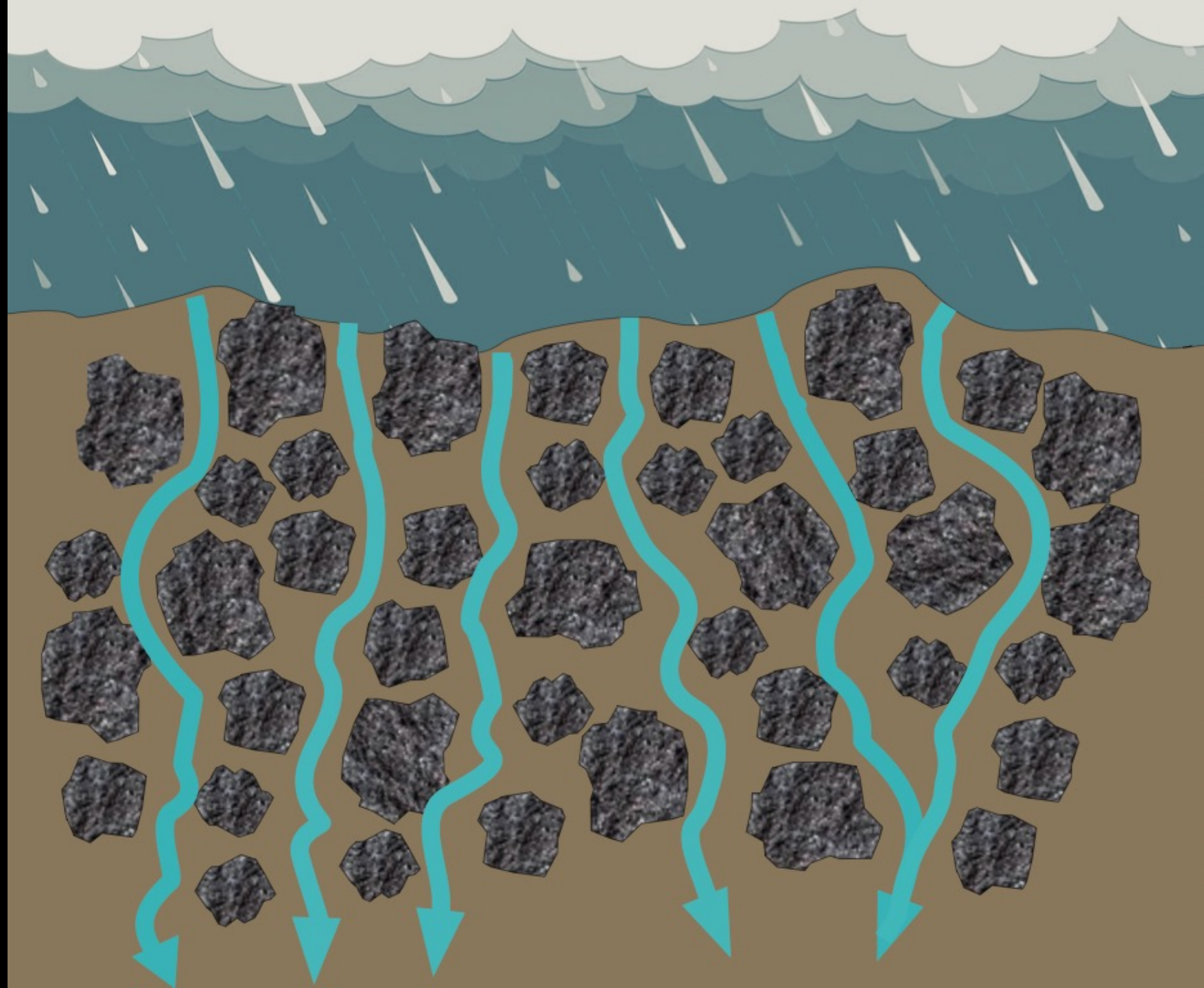
Increases layers of debris, mosses, and lichens over time



**Enhances and
protects soil
development
and soil biology
diversity**



**Old-Growth
protects rain
infiltration to sink
more overland
flows, and reduce
erosion and
downslope
flooding**



Supports wildlife diversity - not just for warblers

Historically,
included jaguars



Photo by Gil Eckrich

Old-Growth sustains year- round gravity spring flows



500 gal/day and
never stops flowing

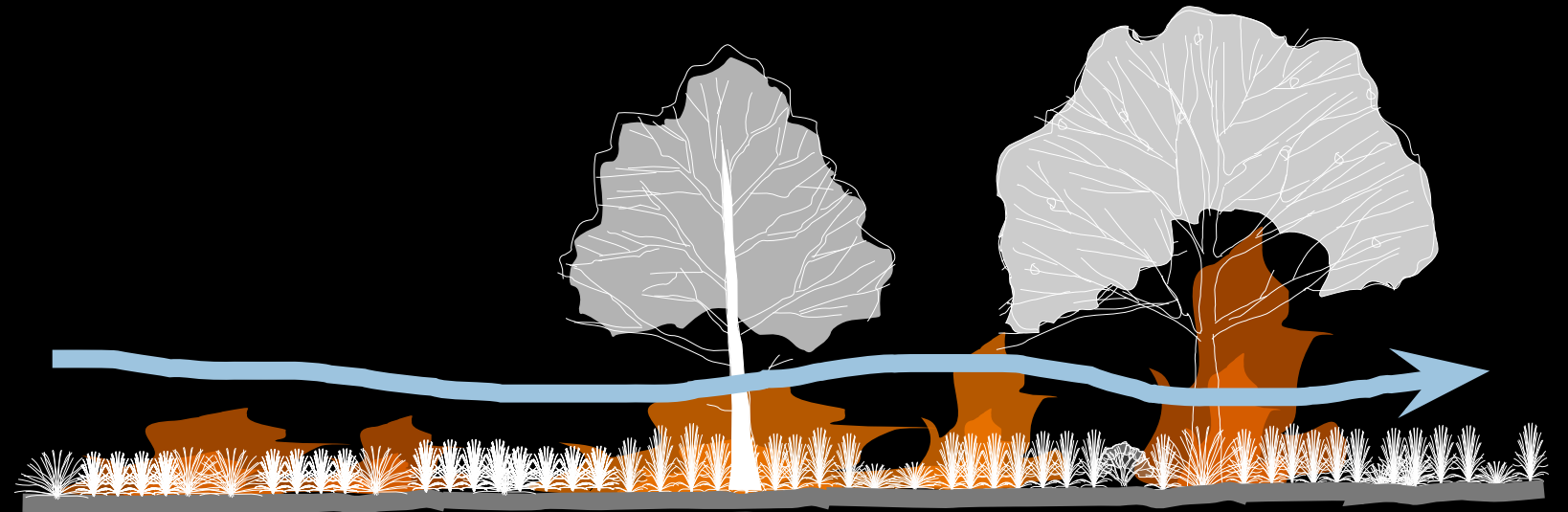


Juniper-oak forested hillside
produced 10K gal/day in spring and
never stopped flowing during last
severe summer's heat wave

**Creates a system
that historically
helped reduce the
spread of fire
from grasslands
into the forest**



Reproducing these effects is
important as our summers get
hotter and longer



Concluding Comments



Junipers on karst country are not the enemy

They are part of the solution

They are not 'invasive' (since they're native and are helping ecosystems)



**Knowing how to read
your land makes more
informed land
management decisions**

Learning juniper cover
types and karst
country basics
improves your read



We need to learn to work with or mimic pioneer thickets to help move this land away from rocky desertification



“Brush management” should be a potential strategy, not the inevitable, overall plan



**We have a soil,
not a cedar, problem**

Questions?



www.projectbedrocktx.org