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Eastern Redcedar and Climate Change in Oklahoma's Cross Timbers Forests

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The Cross Timbers ecoregion serves as a boundary between the Great Plains prairie to the west and the eastern deciduous forest to the east. Throughout the 20th century, Oklahoma's Cross Timbers forests underwent changes in response to settlement and management. Prior to the 20th century, Native Americans commonly used fire in the Cross Timbers. The 20th century ushered in large-scale fire suppression efforts and decreased use of fire, due to European-American settlers' fear of fire. Without fire on the landscape, a process known as mesophication occurred, whereby shade tolerant trees – those that grow in a dark, dense forest – establish and eventually outcompete the trees that grow in full sunlight and are more fire-tolerant. In the Cross Timbers, this was due to the lack of fire, other disturbances or other management practices that keep the forest open, and has resulted in post oak (*Quercus stellata*) and blackjack oak (*Q. marilandica*) being outcompeted by other trees. The main competitor is eastern redcedar (*Juniperus virginiana*), a native tree that was historically confined to rocky outcrops and other areas where fire could not reach it. Eastern redcedar has since spread into Cross Timbers forests and open rangelands, where it rapidly outcompetes other native trees and grasses.

Land use changes such as reduced use of fire, increased forest fragmentation, and the spread of invasive species, coupled with climate becoming hotter and drier, have caused significant changes to the species composition and structure of Cross Timbers forests throughout the 20th and 21st centuries. Research on future climate projections indicates a substantial increase in eastern redcedar and a corresponding decline in oak forests and grasslands throughout Cross Timbers forests over the next 50-100 years. In addition, research indicates supercell storm tracks have already started diverging from what has been historically observed throughout the traditional "tornado alley." More devastating supercell-related events have occurred further east and south in Arkansas and Texas, and fewer in the Oklahoma Cross Timbers. With fewer high-intensity disturbances and less use of fire, closed-canopy forests encouraging shade tolerant and non-fire adapted species like eastern redcedar will become more common. Several decades of research suggest these factors may lead to increased abundance of eastern redcedar. Managing for future changes to Cross Timbers forests should be a priority given the potential for catastrophic wildfire risk, water use and biodiversity concerns.

Recent research suggests that fire intensity may increase in eastern redcedar-encroached Cross Timbers. Under extremely dry conditions, eastern redcedar contributes substantially to flammable vegetation as compared to other trees found in the Cross Timbers. This may result in greater flame heights, increased fire intensity and more erratic fire behavior. When not in drought conditions,



Figure 1. Eastern redcedar will grow under old large oaks and add ladder fuels which bridge gaps between understory fuels, and tree canopies. During drought conditions, this increases chances of transition to canopy fire, which is harder to contain.

eastern redcedar in Cross Timbers forests can limit wildfire risk due to limited vegetation development and lack of fuels under tree canopies. However, because climate change may increase the risk of extended drought and extreme wildfires in forests now dominated by eastern redcedar, the need for management action to reduce eastern redcedar density is more important than ever.

Controlling eastern redcedar is usually accomplished with either expensive mechanical removal or with more cost-effective prescribed fire. However, past research suggests prescribed fire in non-drought years has limited impact on larger trees. Smaller eastern redcedar (<6 feet height) are more susceptible to fire-caused mortality. Therefore any management while eastern redcedar is young greatly improves management efficiency. Older and larger eastern redcedar are more difficult to manage with either mechanical or prescribed fire treatments in the Cross Timbers. If a land manager is cutting down eastern redcedar trees prior to using prescribed fire, leaving cut trees will substantially add to fuel loading, thus increasing fire severity and risk. This can also cause increased mortality of oaks and other trees landowners and land managers may want to retain. Prescribed fire in Cross Timbers forests where eastern redcedar has been mechanically removed may exhibit lower intensity fire, low spatial burn coverage, and may require substantial strip-firing for several years after management.

Management of eastern redcedar is best done while trees are still small. Large trees should be cut and removed prior to using prescribed fire. Whether it is via prescribed fire or mechanical treatment, the difficulty of management will only increase as eastern redcedar trees age and grow larger. If using prescribed fire, options for eastern redcedar removal should be considered based on tree size and current drought conditions. Prescribed burn associations are a good option for landowners with active land management goals to reduce the costs associated with prescribed fire. Given the projected eastern redcedar increase in Cross Timbers forests due to climate change and lack of disturbance or management, properties with wildlife, livestock and recreation goals will require active land management to offset the increase. Understanding how fire behavior changes in response to both eastern redcedar encroachment and active eastern redcedar management is an important consideration for future oak forest managers.



Figure 2. Under drought conditions, eastern redcedar readily contributes to fire behavior and can significantly increase flame heights. Combined with strong wind, this may result in increased firebrands and a higher chance of an escaped prescribed burn.

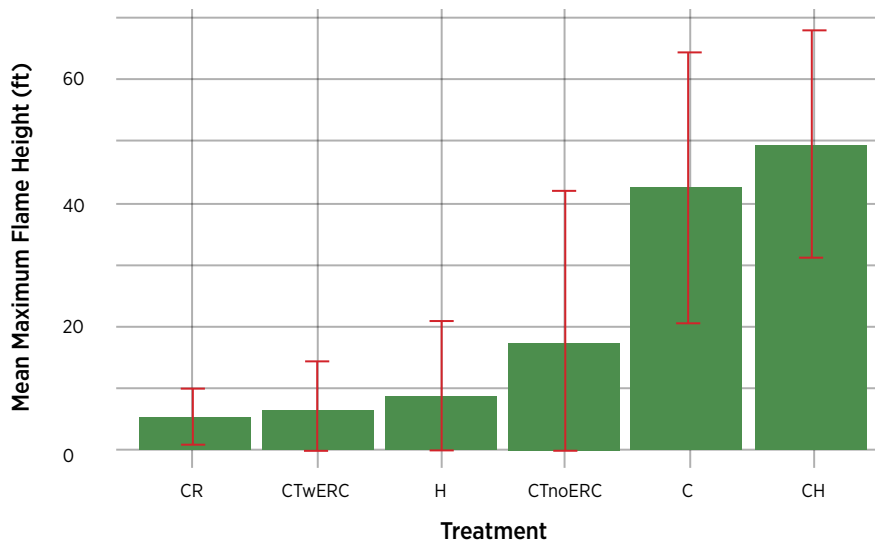


Figure 3. Information from a previous study indicates flame heights differ among management techniques. ERC= eastern redcedar. CH=Cut and leave ERC plus hay added, C=Cut and leave ERC, CTnoERC=Control no ERC, H=Hay added (to ensure surface fuel continuity), CTwERC=Control with ERC, C=ERC cut and removed from forest. Thin vertical bars are standard error, representing the mean plus or minus one standard deviation.

Specific recommendations for landowners and land managers with eastern redcedar in Oklahoma include:

- Properties with wildlife, livestock and recreation goals require active land management.
- Eastern redcedar – while a native tree in Oklahoma – may require active management to exclude it from areas it did not historically occupy.
- Managing eastern redcedar while young can greatly improve management efficiency.
- If using prescribed fire, consider your options for eastern redcedar removal based on tree size and current drought conditions.
- If using prescribed fire, joining your local prescribed burn association can help offset land management costs.

For more information, see:

Yang, J., R. Will, L. Zhai and C. Zou. 2024. Future climate change shifts the ranges of major encroaching woody plant species in the Southern Great Plains, USA. *Earth's Future* 12, 7.

Ashley, W.S., A.M. Haberlie, and V.A. Gensini. 2023. The future of supercells in the United States. *Bulletin of the American Meteorological Society* 104, 1: 1-21.



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