



GREAT PLAINS Grasslands Extension Partnership



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Remove, Reduce, or Manipulate? Best Practices for Brush Management Conservation Standards in Great Plains Grasslands

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Key Takeaways

- Guidelines for brush management promoted by agencies and Extension in the past have been conflicting and ambiguous for several species.
- Woody plant species most likely to cause an undesirable transition from grassland to woodland (state transitions) should be removed from Great Plains grasslands.

Eastern Redcedar | Honey Mesquite | Chinese Tallow | Ashe Juniper | Redberry Juniper

- In grasslands, there is no 'tolerable' level of these woody species. Resource management planners should use updated management guidance based on new research to minimize grassland exposure to seeds of these species. New guidance can be found at <https://cedarliteracy.unl.edu>.

Remove, reduce, or manipulate?

Confusion over whether to remove, reduce, or manipulate woody plants is one of the greatest shortcomings of brush management as a conservation practice in grasslands and rangelands. Past brush management guidance from Extension and agencies addressed the symptoms of woody encroachment, rather than the root cause of the problem [1]. Selective removal and manipulation of woody plants may achieve short-term and local objectives but does not contain the threat of aggressive woody invaders. Today brush management is increasingly expected to contribute to collective efforts to confront the loss of grasslands at county, state, and biome scales [2]. This requires clarity on which woody species warrant complete removal versus species whose presence can be reduced or manipulated to meet local and regional objectives without threat of grassland loss. This factsheet introduces a list of woody species that should always be removed from Great Plains grasslands given their potential to cause large-scale state transitions and negatively impact human well-being (Table 1).

What is the current brush management standard?

The current standards for brush management are designed to achieve a desired plant community based on species composition, structure, density, and canopy cover or height. Removal, reduction, or manipulation of targeted woody plants, including those that are invasive and noxious, is accomplished by mechanical, chemical, burning, or biological methods applied singularly or in integrated combinations [3].

Table 1. Classification of woody plant species based on their potential to cause state transitions at various scales in Great Plains grasslands and corresponding recommendations for brush management standards. The list for species that cause large-scale state transitions is comprehensive, whereas representative examples are provided for other categories.

Classification of woody species			
Woody species that cause large-scale state transitions	Woody species that cause local-scale state transitions		Woody species that do not cause state transitions (but increase or decrease within the historical ecological state)
Eastern redcedar (<i>Juniperus virginiana</i>)	Saltcedar (<i>Tamarix</i> spp.)	Honey locust (<i>Gleditsia triacanthos</i>)	Oak spp. (<i>Quercus</i> spp.)
Honey mesquite (<i>Prosopis glandulosa</i>)	Russian olive (<i>Elaeagnus angustifolia</i>)	Osage orange (<i>Maclura pomifera</i>)	Ponderosa pine (<i>Pinus ponderosa</i>)
Chinese tallow (<i>Triadica sebifera</i>)	Callery pear (<i>Pyrus calleryana</i>)	Other native tree invaders	Sagebrush spp. (<i>Artemisia</i> spp.)
Ashe juniper (<i>Juniperus ashei</i>)	Siberian elm (<i>Ulmus pumila</i>)	Dogwood spp. (<i>Cornus</i> spp.)	Eastern cottonwood (<i>Populus deltoides</i>)
Redberry juniper (<i>Juniperus pinchotii</i>)	Other non-native invaders	Other clonal re-sprouters	Chokecherry (<i>Prunus virginiana</i>)
Species traits			
Notorious woody invaders that can dominate across multiple counties in Great Plains grasslands.	Problematic and invasive woody plants that displace grassland communities and result in local state transitions (e.g., along riparian zones, across pastures and properties) but have not yet shown the capability to dominate Great Plains grasslands at a large-scales.		Native species that co-exist within grass-dominated regions. These species increase and decrease over time but generally do not cause state transitions.
Recommendations for brush management			
Remove ^a	Remove (with exceptions) ^b		Remove/Reduce/Manipulate ^c

^aReduction and manipulation not recommended. Other species like Rocky Mountain juniper (*Juniperus scopulorum*), oneseed juniper (*Juniperus monosperma*), and huisache (*Vachellia farnesiana*) are also known to cause large-scale state transitions, but have limited geographic distributions in the Great Plains.

^bRemoval generally recommended but exceptions occur based on site history/objectives.

^cDecisions to remove, reduce, or manipulate may all be appropriate depending on site/landscape objectives.

Why does Extension guidance and brush management standards need to be changed?

The lack of clarity on whether to remove, reduce, or manipulate woody plants, as well as the species and circumstances in which different tactics apply, has led to ambiguity in how to use brush management in Great Plains grasslands. The result is widespread use of brush management tactics that leave behind aggressive woody invaders that drive rapid reinvasion and prevent sites from achieving the desired plant community [1,4]. In addition, the most aggressive invaders continue to be planted in grasslands due to a lack of clarity on the relative risk that native and non-native species pose to Great Plains grasslands.

Why recommend the removal of species that cause large-scale state transitions?

We recommend the removal of woody species that cause large-scale state transitions because these species disproportionately account for severe consequences of woody encroachment in Great Plains grasslands, including:

- **Lost forage production.** Great Plains grasslands lose 22.4 million tons of forage for livestock every year to woody encroachment. This equates to an annual economic impact of \$323 million and continues to increase every year [5,6].

- **Heightened wildfire danger.** The number and severity of wildfires are increasing due to the large-scale expansion of volatile woody fuels in the Great Plains [7-9].
- **Reduced water quantity and quality.** Woody encroachment in grasslands can reduce stream flow and aquifer recharge, while increasing pollutant and sediment concentrations [10,11].
- **Higher risk of soil erosion.** Woody encroachment reduces grassland plants and increases bare ground cover, resulting in a higher risk of erosion during rainfall events [12].
- **Less funding for public education.** School lands generate income from grazing leases to support public education. Woody encroachment decreases the profitability and future school funding from these grazing leases [13].
- **Vector-borne disease risks.** Woody encroachment increases the risk of vector-borne diseases like West Nile virus and Rocky Mountain spotted fever in grasslands [14].
- **Increased allergen potential.** Pollen from woody plants contribute to seasonal allergies and threaten human respiratory health [15].

In addition, large-scale state transitions from grassland to woodland are cost-prohibitive and difficult to reverse. In fact, there are no examples of restoring large-scale grasslands after transitioning to woody dominance, despite significant investments in brush management.

Why are large-scale transitions better than focusing on native vs. non-native classifications?

New recommendations reflect the risk that woody plants pose to human well-being in Great Plains grasslands, which native vs. non-native classifications do not capture. Native plant invasions are widespread globally and often result in large-scale state transitions with impacts that rival and exceed those of non-native invaders [15].

Four of the five species listed as causing large-scale state transitions (Table 1) were native but rare species in the Great Plains prior to European settlement. These species exhibit traits that allowed them to persist in the Great Plains for millennia despite frequent fire, drought, and herbivory [17,18]. These same traits, coupled with fire exclusion and widespread planting, have resulted in these species becoming aggressive native invaders. Additional woody species that can cause large-scale state transitions may emerge if brush management fails to contain species that currently cause local state transitions and this list will be updated in the future to account for these potential changes.

Summary

- This factsheet provides clarity to improve Extension and agency guidance on what species should be removed with brush management versus those species that can be reduced or manipulated in grasslands.
- Woody species that should be removed from Great Plains grasslands are those that cause large-scale state transitions and negatively impact human well-being.
- Five woody species meet the criteria of causing large-scale state transitions and disproportionately account for the negative impacts and collapse of Great Plains grasslands due to woody encroachment.
- There is no 'tolerable' level of woody species that cause large-scale transitions from grassland to woody dominance. Species like eastern redcedar and honey mesquite should not be managed like sagebrush and oak. Rangeland managers should use brush management differently for these species and act as soon as possible to remove them.
- Apply Twidwell's (2021) guide for understanding risk and vulnerability to sustain brush management investments, prevent reinvasion, and avoid long-term costs and consequences of woody transitions [19].

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