

Juniper Invasions in Grasslands: Research Needs and Intervention Strategies

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On the Ground

- Despite prescribed fire programs, invasive juniper trees are increasing in the Great Plains.
- Continued encroachment of junipers in the Great Plains, especially eastern redcedar and Ashes juniper, is degrading grasslands and increasing health concerns through pollen production.
- Biological and ecological research needs include effects on soil and water as well as restoration potential after a mature invasion is treated.
- The interface of social science, ecology, economics, and policy may yield productive approaches to slowing the invasion.

Keywords: fire, eastern redcedar, economics, invasive species, *Juniperus*, policy.

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Successful grassland conservation efforts seek to understand the relationship of people to land in addition to ecological complexities.¹ Grassland management challenges are frequently the result of multiple causes.

Juniper encroachment in grasslands of the Great Plains provides a present day case study of these complex biological and anthropogenic interactions with important implications for biodiversity. Research has shown that mesic grassland can be converted into juniper woodland in as few as 40 years² with cascading effects for grassland and human health.

The evolutionary history and loss of grasslands is intertwined with that of humans. Indigenous people maintained grasslands through the use of fire followed by agriculturalists who degraded some grasslands (through overgrazing, cultivation, and fire suppression) but have continued to maintain and restore others

for livestock production and soil stability. Recently, conservationists have recognized grasslands as one of the most imperiled ecosystems globally and have become interested in maintaining them for their unique biodiversity.

Grassland is the primary plant community type (with 30.1% of historic levels remaining) in the Great Plains bioregion of North America.³ The United States has the fourth greatest grassland area (3.3 million km),^{2,4} but these grasslands have rapidly changed over the last 150 years. The tallgrass prairie of North America has seen extensive losses, with only 9% remaining,⁴ and shortgrass and mixed-grass prairies also have sustained substantial losses.^{3,4} Landscape fragmentation has increased because of agriculture and urban/exurban development.

Natural processes such as fire and grazing, which once maintained a vast, continuous grassland landscape, have been decoupled, resulting in alterations of both fire and grazing frequencies and intensities.^{5,6} Fire and grazing are critical processes that interact to prevent the transition of grasslands into woodlands.^{7,8} Current Great Plains residents, along with earlier settlers, have typically suppressed fires, with the exception of American Indians.^{9–11} The result is a changing Great Plains landscape that includes much greater woody cover (Fig. 1).

The reversal of the region-wide expansion of *Juniperus* spp. is a linchpin to successful grassland conservation.¹² As grasslands become fragmented and lost, associated endemic organisms will also be lost. In particular, grassland birds are sensitive to fragmentation by woody species invasion and serve as indicators of ecosystem change.^{13–15} In North America, the breeding bird surveys have reported a constant decline in grassland bird populations. As a guild, grassland birds require diverse vegetation structure and some species (i.e., prairie grouse species) have low tolerance for trees.^{12,16}

There are 13 species of juniper in the United States, as cited in Van Auken,¹² and the most widespread juniper species in the Great Plains are fire-sensitive [e.g., eastern redcedar (*Juniperus virginiana* L.) and Ashe's juniper (*Juniperus ashei* J. Buchholz)].¹⁷ Decreased fire frequency led to expansion of these species ranges and abundances.^{7,12,18} Juniper expansion has reduced the available grassland habitat and livestock forage, accelerated biodiversity loss, increased fuel management

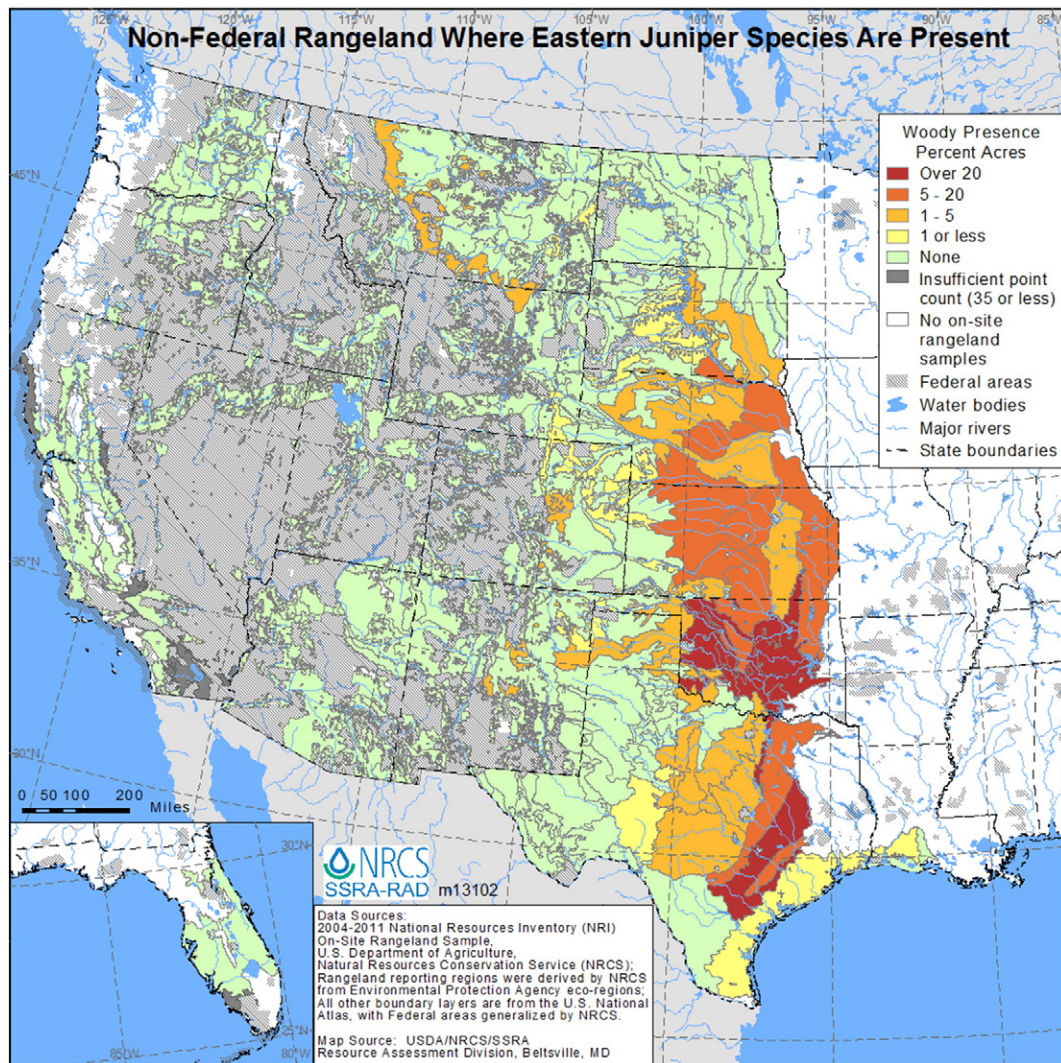


Figure 1. Non-federal rangeland where eastern juniper species are present. Photo courtesy of USDA-Natural Resources Conservation Service. Available at https://www.nrcs.usda.gov/Internet/FSE_MEDIA/stelprdb1253985.png.

concerns, and increased public health concerns from allergenic pollen.^{12,18,19} Our discussion focuses on eastern redcedar and Ashe's juniper as they are of the greatest concern and perhaps the most easily controlled of the Great Plains juniper species.

Understanding how changes in disturbance and land use through time led to range expansion of invasive juniper trees is critical to developing solutions for restoration and grassland conservation. We will discuss how the history of juniper expansion in the region is intimately tied with fire history and policy. Our work further describes how the threat of juniper encroachment may be mitigated by solutions that provide information and outreach in the areas of biology, social science in the areas of culture, economics, policy, education, and outreach, and focused application of existing data.

A Human History of Juniper Encroachment in the Great Plains

Juniper encroachment in the Great Plains can be better understood through the lens of human interaction with

grasslands through time. Around 1770, human population shifts occurred concurrently with increased disease rates among American Indians and the decline of bison and other wildlife.²⁰ The Homestead Act of 1872 opened the Great Plains up for rapid colonization and agricultural conversion, accelerated by additional changes in national land use laws.²⁰ Prior to settlement of the Great Plains (1770-1880), fires were both frequent and expansive in extent and originated from both human and natural sources^{17,21} including the frequent use of fire by indigenous groups.^{10,11,17}

American Indians used fire to facilitate hunting, manage food plants and wildlife habitat, fireproof settlements, conduct warfare, communicate, facilitate honey collection, and facilitate travel (summarized by Sauer²²). While debate continues on definitively how, when, and why²² American Indians used fire, and the impact of their fires on regional ecosystems, there is consensus that American Indians used fire to achieve specific goals.^{10,23}

During the period from 1870 to 1885, after the demise of bison and before widespread cattle production began,

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