

EASTERN REDCEDAR IN NEBRASKA: PROBLEMS AND OPPORTUNITIES

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Introduction

Eastern redcedar, *Juniperus virginiana*, (cedar) is a native tree that has always been a fixture on the Nebraska landscape, providing valuable wood products, wind and soil protection, and habitat for a variety of species of wildlife. However, the rapid spread of cedar is an increasingly serious ecological and economic issue with substantial impacts statewide. Addressing the spread of cedar poses challenges of a magnitude that dwarfs the capacity and resources of any one agency or organization. Taking a collaborative approach, in 2013 the members of the Nebraska Conservation Roundtable came together to develop a vision for addressing the rapidly expanding population of cedar in Nebraska, define the extent of the problems, determine the opportunities cedar presents, and identify specific actions to achieve this vision.

Our Vision: Roundtable partners envision a future where:

- grasslands and pastures are managed in ways that reduce cedar populations to improve grass health, vigor and resilience, enhance and conserve native wildlife habitat in grasslands, and protect species diversity at the landscape scale;
- forests containing cedar are managed to enhance timber quality and economic value of all species, increase plant and wildlife diversity within forests, enhance forest ecological resilience and function, and reduce the risk of catastrophic wildfire; and
- cedar is a valuable tree species on the Nebraska landscape, with multiple and profitable markets for its wood, contributing to landowner income, job creation and economic development.

Eastern Redcedar: Problem and Opportunity

Historic and Current Rates of Spread: Cedar, a tough and hardy native tree species, is rapidly expanding across much of the state, in part due to its adaptability to a wide range of conditions, the lack of fire on the landscape (both prescribed fire and wildfire), changes in farm and grazing practices, drought, lack of grassland and forest management, changes in land ownership patterns, and conservation plantings as a seed source. Cedar has expanded more than any other species across much of the Midwest and Great Plains (Figure 1), with Nebraska experiencing the greatest forest density of cedar trees/acre of any other Midwestern state (Figure 2) (USFS FIA 2016), and until 2012, a near exponential rate of spread in Nebraska (Figure 3). The spread of cedar in Nebraska is especially significant from west-central to eastern NE (Figure 4).

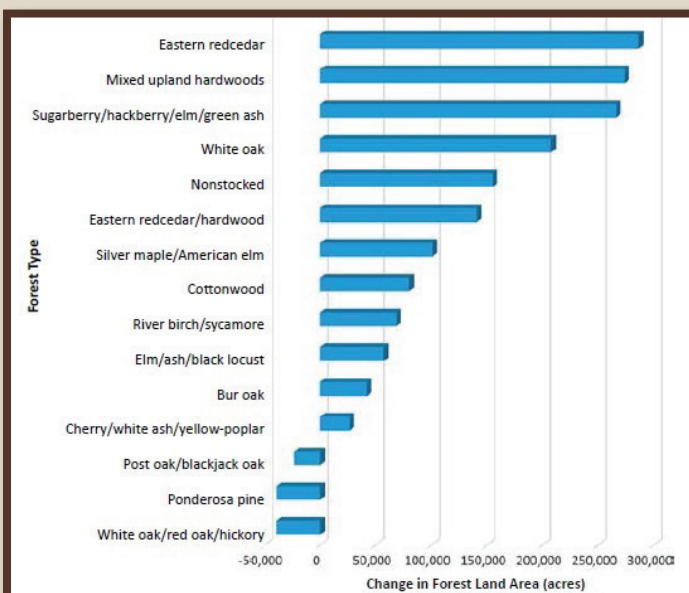


Figure 1. Forest expansion the central US by species state, 2005-2012

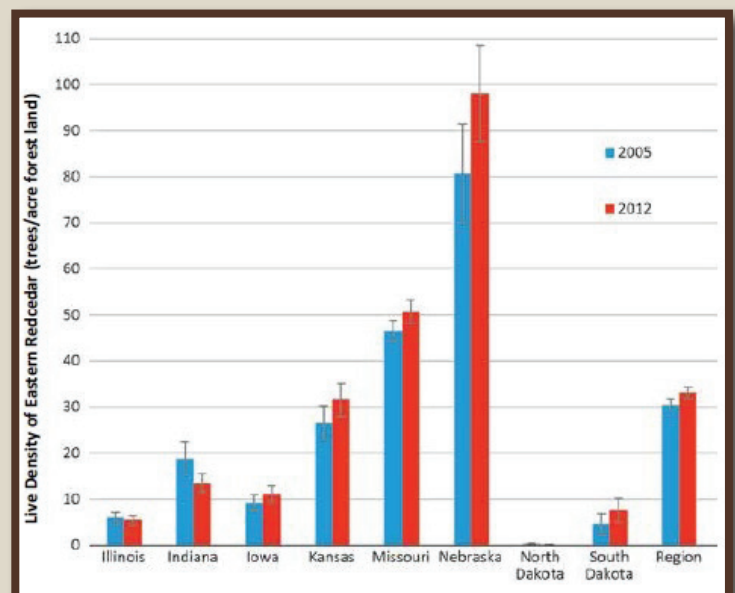


Figure 2. Changes in cedar forest density by state, 2005-2012

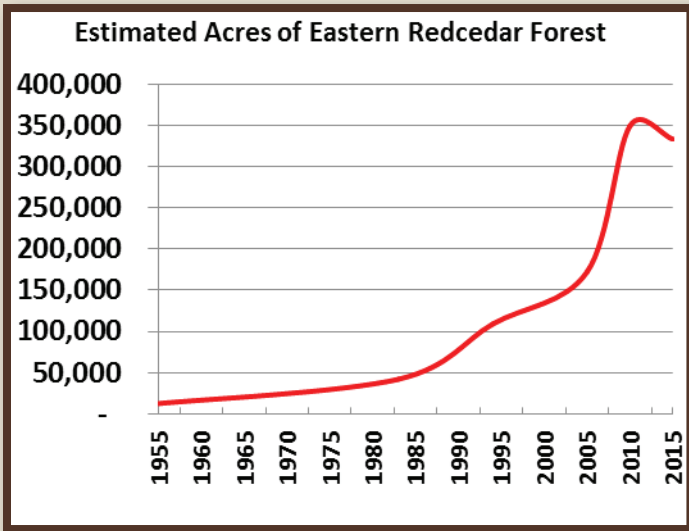


Fig. 3. Historic expansion of cedar forest acres

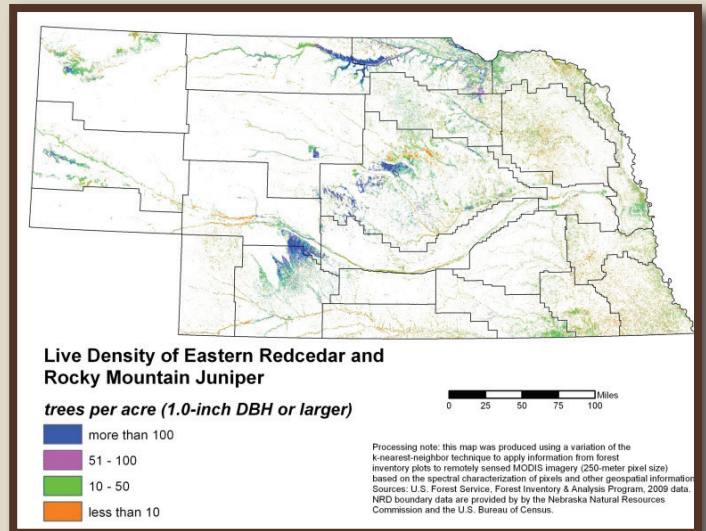


Figure 4. Density of cedar within Nebraska forests (2009 data)



Early spread of cedar into grasslands.



Heavy cedar growth in grassland





Large-scale cedar forest establishment in grasslands, Loess Canyons, NE

Cedar encroachment under pine forest, Niobrara Valley.

Estimated at 333,134 forested acres in 2015, cedar now constitutes 22% of Nebraska's forest area . Average annual rates of spread from 2005 to 2010 were approximately 25,000 acres/year of new cedar forest occurring in former grasslands, and 13,000 acres/year of existing forest being converted to a cedar forest type (Figures 1 & 2). However, this rate of spread has slowed since 2009. Data from 2013-2015 indicates that cedar forest decreased by 30,000 acres as a result of mechanical removal and/or prescribed burning of former (reclassified) grasslands as well as mechanical cedar removal from under forests.

It is important to note that cedar occurring at low densities and as very small trees in grasslands are not included in these data, as they do not meet the criteria to be classified as forest. Once these trees grow to the size of having a stem diameter >1" at 4.5' above ground level and a stocking level of at least 10%, the area is then classified as cedar forest and is included in forest inventory findings. Unfortunately, once new areas of cedar reach this size and density, with much higher fuel loads, their management has already become more complex and expensive.

USFS FIA Inventories of tree seedlings (trees <1" in diameter at 4.5' above ground level) estimate that cedar seedlings are the second largest seedling population in Nebraska's forests, with one of the fastest rates of population increase (Figure 3). Between 2005 and 2015, the number of cedar seedlings in forests doubled to nearly 275 million . While there are no inventory data available that measure encroachment of grassland by cedar, there are anecdotal observations that note the existence of large numbers of small seedlings in grasslands across central and eastern NE. Combined, these trends imply that there exists an enormous pool of seedlings that will eventually convert large areas of existing pine and deciduous forests and grasslands to cedar. The large number of seedlings in grasslands implies that an important window of opportunity may currently exist for the expanded use of prescribed fire to reduce these numbers while the trees are still small. When these seedlings in grasslands grow larger and increase in numbers, substantially increased fuel loads will complicate the use of prescribed fire.

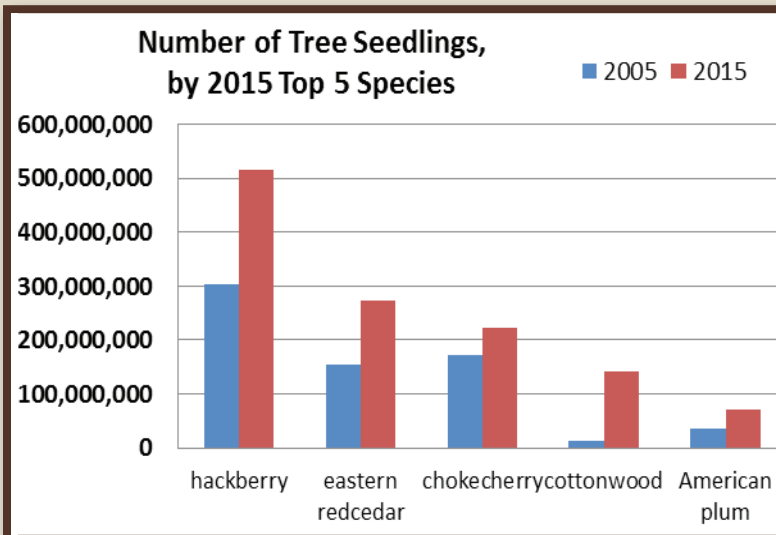


Fig. 5. Number of Seedlings (<1" diam.)

¹ Forest land is defined by the US Forest Service Forest Inventory Analysis Program as land that is at least 10 percent stocked by trees >1" in diameter, be at least 1 acre in size, at least 120 feet wide.

² Stocking is the percentage of the optimal # of trees in a stand.

³ US Forest Service Forest Inventory and Analysis program, 2015 data.

Negative Ecological and Economic Impacts

The spread of cedar into forests and grasslands has a number of negative impacts:

- Loss of native grassland habitat for grassland nesting birds and other wildlife species associated with grasslands.
- Reduced grazing land productivity due to reduced grass health, availability, vigor and species diversity.
- Increased risk of catastrophic loss of life and property and large economic losses due to uncharacteristic wildfire [e.g., suppression costs, loss of physical infrastructure, human health impacts (fire, smoke), damage to soils, flooding, reduced air quality]
- Altered forest structure and function of existing deciduous and pine forest communities.
- Reduced biological diversity in both grasslands and forests, with potentially negative impacts to sensitive species and/or Threatened or Endangered (T&E) species
- Loss or degradation of native riparian forest communities (e.g. cottonwood gallery forests) important to many wildlife species, game and non-game, and sensitive species such as bald eagles.
- Reduced water availability due to increased water use and interception by cedar as compared to upland grasses and forbs.
- Changes in stream channel morphology and altered natural hydrology.
- High costs to landowners for cedar removal and disposal using mechanical methods followed by prescribed fire.

The Dilemma

Cedar is severely impacting our grassland, forest, water and wildlife resources on a very large scale. It is expensive to mechanically clear cedar that has encroached into grasslands or under existing forests. Using prescribed fire, grasslands are best managed with low populations of cedar of small size. Grasslands with heavy cedar fuel loads and large trees can be challenging to burn safely, and remaining cedar skeletons still need to be mechanically removed post-fire. Forests (especially ponderosa pine forests) with cedar in the understory often cannot be safely burned at all until the cedar understory is mechanically removed. Current average costs for mechanical removal range from \$120/acre to \$1,000/acre depending on tree density, size, plant community, soil type and topography. At an average cost of \$600/acre, it would cost nearly \$23 million/year to mechanically clear 38,000 acres of cedar forest annually just to stay even with expansion that was observed during 2005-2010. Hundreds of millions of dollars would be needed to manage 333,000 acres of existing cedar forest. Mechanical removal should also be followed by prescribed fire to eliminate small seedlings and seed. While prescribed fire should play an important and cost-effective role in cedar management, topography, fuel loads, limited safe burning weather windows and liability can all limit its overall use on a large scale. While subsidy programs can have significant impacts, securing \$23 million/year or more for cedar clearance programs is not likely to be realistic, and may not be the best use for scarce funds.

Given limited financial resources and other barriers, a multifaceted approach to manage cedar is urgently needed to expand mechanical removal and prescribed fire programs, and to develop new and novel market-driven utilization approaches. Creating economic markets for cedar wood and other materials would promote and financially support its removal for various products, while at the same time promote conservation of important wildlife habitat such as native grasslands and cottonwood riparian forests.

Opportunities: Positive Benefits of a Growing Renewable Wood Resource

Nebraska's cedar trees (1" diameter or larger) currently contain more than 8.9 million tons of wood . Approximately 50% of this biomass is contained in trees <9" in diameter. As these existing trees grow, cedar wood volume will rapidly increase, substantially augmented by the addition of millions of new trees in coming years.

Establishing markets for cedar wood would create a number of benefits, including:

- Establish a sustainable economic driver for cedar management that simultaneously achieves economic, conservation and restoration goals.
- Generate income from salable, value-added products for multiple markets such as timber products, bioenergy, mulch, animal bedding, biochar, chemicals, specialty products, etc. Cedar lumber is the one of the most valuable woods produced in Nebraska, second only to walnut.
- Cedar-based businesses would foster local economic development, job creation and reduced energy costs.
- Increase productivity of grazing lands, with increased rancher income.
- Reduced GHG emissions from facilities shifting from fossil fuels to cedar biomass.
- Increased burning of cedar in boilers instead of in open slash piles, reducing GHG emissions (including methane) by 50%.

⁴ Cedar populations in grasslands that have not yet reached the minimum numbers and density to qualify as forest are not tracked by any agency or organization in Nebraska.

⁵US Forest Service Forest Inventory and Analysis program, 2015 data (modified to represent weight of green wood).

⁶US Forest Service Forest Inventory and Analysis program, 2015 data.

Market Potential

Based on existing woodchip market prices, cedar woodchips delivered to a boiler for thermal applications are valued at between \$45 and \$65 per ton. At these prices for relatively low value woodchip fuel, the current standing cedar biomass resource of 8.9 million tons⁵ currently growing in Nebraska is worth between \$400 and \$580 million. Being a renewable resource, cedar forests produce approximately 345,000 tons⁶ of new wood every year, nearly all of which grows on private land. Annual growth in cedar statewide could sustainably and indefinitely generate between \$16 and \$22 million in wood chip sales every year, should markets be developed for this resource.

Higher-value markets such as sawlogs, fence posts, and wood shavings are also significant opportunities. Nebraska's cedar forests contain approximately 3.6 million tons⁵ of sawlogs and 2.4 million tons⁵ of post sized material, with the remaining 2.9 million tons⁵ comprised of low-value trees and tree tops and limbs removed from trees turned into sawlogs and other products. With the current market prices of sawlogs (\$60-\$120/ton) and post-size materials (\$45-\$80/ton), the sawtimber and post-timber component of the state's cedar population has a value of \$324-624 million. The remaining 2.9 million tons⁵ still have the opportunity to be sold in wood chip markets (biomass, mulch, etc.), with a value of \$130-190 million. This "higher value" model of cedar utilization increases the total value of the state's cedar resource to \$455-813 million, statewide.

Current Efforts That Address the Spread of Cedar

- **Financial assistance programs for cedar mechanical removal.** A number of federal and state agencies and NGOs [NRCS, Nebraska Forest Service (NFS), National Wild Turkey Federation (NWTf), NE Game and Parks Commission (G&PC), among others] provide landowners statewide with several million dollars annually in cost-share funds, as well as on-the-ground technical assistance to mechanically remove, pile, and chip or burn cedar debris on grasslands and in forests.
- **Financial assistance programs for prescribed burning** of cedar grasslands, and for burning cedar slash piles in forests. Several federal and state agencies and NGOs (NRCS, NFS, TNC, Pheasants Forever, G&PC, and NWTf) provide cost-share funds, training and/or technical assistance in the use of prescribed fire, burning thousands of acres/year.
- **Forest management assistance.** The NFS and NRCS provide landowners with cost-share funds to thin existing pine and cedar forests to maximize forest health, resilience, productivity and value.
- **Market and Business Development.** Several financial assistance programs (grants, low-cost loans, etc.), as well as technical assistance are available from federal and state agencies to support the development or expansion of businesses or organizations that process or use cedar, including USDA Rural Development, Nebraska Department of Economic Development, Nebraska Department of Environmental Quality (equipment grants), Small Business Administration and the NFS.
- **Outreach and Education.** Many organizations work to inform and educate the public, landowners and decision makers on cedar issues and opportunities via publications, newsletters, electronic/social media, etc.

Addressing the Cedar Challenge: A Road Map for Action

Members of the Nebraska Conservation Roundtable identified the following necessary actions that together comprise a comprehensive strategy that addresses the expansion of cedar:

- Better define the problem and identify priority geographic areas for action
 - Conduct intensive aerial and on-the-ground inventories, especially of grasslands and rangeland
 - Geospatially map:
 - Cedar occurrence, density, height, age, etc.,
 - Land ownership patterns (absentee/rental vs owner-operated rangeland)
 - Compare to previous surveys where available to identify areas with greatest rates of spread
 - Grassland productivity (current and without cedar)
 - Conduct geospatial analysis to determine areas where interventions will show the greatest impacts (e.g., on highest productivity grasslands) and where interventions will show greatest relative chance for success (e.g., areas with low to moderate density cedar)
 - Develop criteria for determining priority areas (economic benefits, wildlife benefits, reduce risk to wildfire, etc.)
 - Delineate priority areas and develop targeted programs
- Facilitate development of new cedar products, markets and businesses that provide sustainable, long-term economic incentives and market drivers for cedar removal, processing, marketing and management
 - Expand existing and establish new financial and technical assistance programs to increase the number and capacity of cedar harvesting and processing entrepreneurs

- Expand business recruitment and economic development efforts to attract new enterprises to Nebraska to utilize the cedar resources
- Facilitate development of efficient and cost-effective tree-to-user processing and supply chains
- Expand existing and establish new financial and technical assistance and outreach programs to increase the number of users (private and public) of cedar products.
- Initiate/expand financial assistance for development of new cedar products with large volume, large-scale potential (e.g., bioenergy, mulch, animal bedding, biochar, chemicals, timber products, specialty products, goat meat, etc.)
- Work with the state's forest products industry to identify and address business development barriers
- Identify alternative species for windbreaks and educate landowners about those alternatives
- Expand cedar mechanical and prescribed fire removal and management cost-share and technical assistance programs
 - Target technical and financial assistance to specific groups, especially resident and absentee landowners.
 - Identify lower risk prescribed fire approaches
- Develop, test and promote innovative approaches that support cedar removal on grasslands such as integrating goats into grazing systems.
 - Conduct targeted research
 - Map the cedar genome with particular emphasis on identifying markers that determine male and female trees
 - Develop genetic tests at the seedling stage to detect tree gender to enable roguing of female trees in the nursery.
 - From existing cedar stands, identify individual male trees with superior characteristics with potential for clonal production
 - Develop vegetative propagation and tissue culture techniques for the mass production of male trees with superior characteristics
 - Develop conservation planting designs that would allow for elimination of female cedar trees upon detection while preserving the function of the planting.
- Conduct policy and legislative analysis
 - Examine federal and state policies and current state statutes to identify conflicting statutes or regulations, barriers for cedar management, and changes that would improve large-scale management.
 - Make recommendations and facilitate influencing efforts to secure needed legislative and/or regulatory changes.
- Conduct extensive education and outreach activities
 - Target consistent messaging to specific groups: e.g., resident and absentee landowners, businesses and entrepreneurs, policy makers, agency personnel and decision makers.
 - Develop educational and outreach materials that document the scope, severity of current and future expansion, and priority areas for action
 - Develop BMPs and technical guides on:
 - cedar forest management,
 - managing grasslands with cedar,
 - using prescribed fire for cedar reduction and management
 - methods for cedar mechanical, chemical and other control measures.
- Identify new potential partners for joint action and coalition building such as the NE Invasive Species Council, NE Eastern Redcedar Task Force, and the Prescribed Fire Council.

ORGANIZATIONS AND AGENCIES SUPPORTING THE EASTER RED CEDAR ISSUE PAPER:

Nebraska Wildlife Federation

Nebraska Ornithologists' Union

Crane Trust

Ducks Unlimited

Sierra Club

U.S. Fish and Wildlife Service – Partners for Fish and Wildlife Program

Sandhills Task Force

The Nature Conservancy

Nebraska Game and Parks Commission

Nebraska Cooperative Fish and Wildlife Research Unit

Nebraska Forest Service

National Wild Turkey Federation

Nebraska Sportsmen's Foundation

Nebraska Land Trust

Playa Lakes Joint Venture

Audubon Nebraska

Nebraska Natural Resources Conservation Service

Nebraska Big Game Society