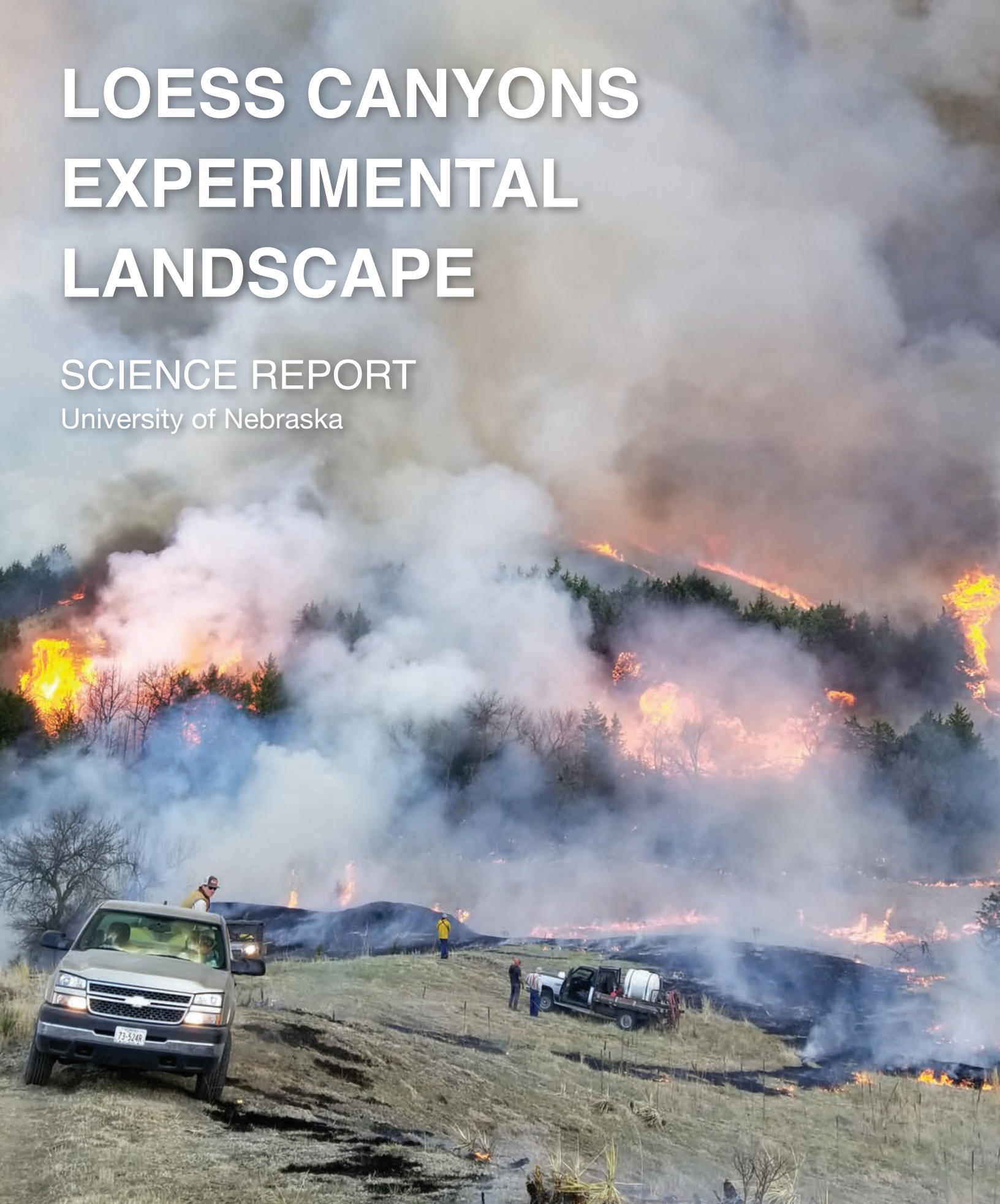


# LOESS CANYONS EXPERIMENTAL LANDSCAPE

SCIENCE REPORT

University of Nebraska



RESEARCH HIGHLIGHTS - 2016-2021





University of Nebraska. 2021. Loess Canyons Experimental Landscape: Science Report. University of Nebraska-Lincoln, Large-Scale Rangeland Conservation Lab. Lincoln, Nebraska.



Erin McCready

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*This report is the result of a unique partnership between landowners in the Loess Canyons, Dr. Dirac Twidwell's lab at the University of Nebraska, and multiple supporting agency partnerships. Ultimately, the accomplishments highlighted in this report would not have been possible without the exceptional landowner stewards of the Loess Canyons. To say that Gordon Gosnell, Mark Alberts, Rich Bringelson, Scott Stout, Stan Pilcher, and Vernon Hansen played an important role in starting landowner-agency partnerships more than a decade ago would be a significant understatement. Special thanks is also owed to Doug Whisenhunt (originally with The Nature Conservancy and then NRCS), Mary Reece (NRCS), Jeff Nichols (NRCS), and T.J. Walker (Nebraska Game and Parks Commission) for providing foundational agency support in the early days when the Loess Canyons Rangeland Alliance was just getting started. In more recent years, Andy Moore (Pheasants Forever) has played a critical support role in helping get more fire on the ground. As scientists, we appreciate the opportunity to fulfill our modern vision of the land grant mission and to be a valued partner in the Loess Canyons. Many other men and women from Nebraska Game and Parks Commission, Nebraska Natural Resource Conservation Service, Pheasants Forever, Nebraska Environmental Trust, University of Nebraska, the U.S. Fish and Wildlife Service, and Working Lands for Wildlife played important support roles that ranged from funding conservation actions to communicating the importance of landowner-led efforts nationally.*



## Welcome Messages



Erin McCready

### SCOTT STOUT

*N-N Ranch Inc., President of the Nebraska Prescribed Fire Council and former President of the Loess Canyons Rangeland Alliance*

**O**ur ranch, like many others in the Great Plains, is being taken over by eastern redcedar. This affects the way we operate productively, so like many other ranchers in the Loess Canyons, we have done something about it.

With neighbors helping neighbors we have reclaimed our grasslands with the use of prescribed fire. Since 2002, we've reclaimed more than 80,000 acres of grasslands from eastern redcedar. With over 50 active landowner members in a 200,000-acre area, we have utilized large-scale burning to improve our rangeland resources from eastern redcedar.

Partnerships have proven to be critical for our progress with prescribed fire in the Loess Canyons. Partnerships with conservation agencies like Nebraska Game and Parks, Pheasants Forever, and USDA's Natural Resources Conservation Service (NRCS) have created a functional network of people working to restore our grasslands.

Being able to have the science as a part of our efforts has also had a huge impact, especially

with explaining why prescribed fire is needed throughout our region. In 2014, we partnered with Dirac Twidwell and his team at the University of Nebraska-Lincoln. They provided us with back-and-forth communication that we didn't expect from scientists that made the partnership so productive. We are able to inform our efforts with the science and they are able to help communicate the importance of what we are doing on a bigger stage.

One thing I hope the Loess Canyons can provide to other groups beyond our borders is the foresight that now is the time to come together as a community and save our prairies.



Mark Alberts

### MARK ALBERTS

*President of the Central Platte Rangeland Alliance*

**P**eople think they have a section of grass when in fact they have a section of land, a section of fence, and a section of taxes, but they no longer have a section of grass. The 'green glacier' of eastern redcedar encroachment is taking over our grasslands at an incredible rate. This is why the Central Platte Rangeland Alliance accomplishes what others say is impossible - conducting 1,000 + acre burns and killing 85 percent of mature eastern redcedar. From our perspective it's clear - without fire, rangelands lose.

The Central Platte Rangeland Alliance is a group of farmers, ranchers, and business men and women focused on putting fire on the ground and doing more with our conservation practices to get back rangeland acres lost to cedar encroachment. We've developed a comradery of people built around our passion for using prescribed fire to revitalize and restore rangelands. We operate across a 100,000-acre region of the eastern Loess Canyons and have restored more than 50,000 acres with prescribed fire since our inception in 2011.

The backing and support from conservation agencies has been critical to our ability to adopt prescribed fire and innovate and advance new approaches for large-scale cedar control. NRCS, Nebraska Game and Parks Commission, Pheasants Forever, and Twin Platte and Central Platte Natural Resource Districts are all exceptional partners that play a critical role. Doug Whisenhunt with the NRCS, specifically, was instrumental in the region's early adoption of prescribed fire for cedar control.

While we have a long way to go, we've made substantial progress since prescribed fire was adopted in the Loess Canyons more than 20 years ago. My message to other landowners is that now is the time to talk to your neighbors and take action to protect our rangeland resources.

## DIRAC TWIDWELL

*Rangeland Ecologist at University of Nebraska-Lincoln*

**L**andowners in the Loess Canyons have done something truly remarkable: This is the first place we documented where people have successfully halted the regional expansion of eastern redcedar. These landowners offered unprecedented access to their private land, allowing my lab of researchers to better study how fire affects the animals, plants, and people who live there. Thanks to their trust, we can deliver scientific evidence that prescribed fire is sustainable—and



University of Nebraska-Lincoln

pivotal—for preventing grassland loss, restoring rangeland lost to woody encroachment, and improving ecosystem services in grasslands.

This large-scale experimental landscape is a model for the future and one of the most rewarding scientific pursuits of my career. Lessons learned here are guiding innovation in rangeland fire management elsewhere. We are now establishing new experimental landscapes, allowing us to share stories across landowner communities, and rapidly incorporate landowner ingenuity into science-based solutions that can successfully manage the threats facing rangeland producers and conservationists this century.

One final note: The Loess Canyons is one of the only examples in the world where a community of private landowners resurrected a culture of fire. In most places where people stopped regularly burning prairies, they haven't started fires again—at least not yet. The science from the Loess Canyons Experimental Landscape shows it's not only possible to restore fire at large scales, but it's also one of the best ways to save the grasslands that support our way of life and well-being in the Great Plains.

# The Story of Saving the Loess Canyons

Brianna Randall, Working Lands for Wildlife

Andy Moore

**W**hen Mark Alberts' dad and grandparents used to go in search of their family Christmas tree, it often took hours to hunt down a lone redcedar in southwestern Nebraska. Unfortunately, redcedars have since taken over much of America's fertile prairie. The rangelands south of the Platte River valley are now one the most tree-infested areas in Nebraska.

The rapid invasion of eastern redcedar across America's Great Plains spells bad news for landowners and communities that rely on grass. These trees replace native grasses, which means less food for livestock and less revenue for ranchers.

"It's called the 'green glacier' since the trees are invasive and grow so fast," said Alberts, a 63-year-old farmer and rancher who has lived in Nebraska's Loess Canyons his whole life. "The problem keeps compounding. Grandpa and Dad used to run 80 calf-cow pairs on a section of grass. But when that section is half covered by trees, it can't feed as many cattle."

Not only do the invading trees cut into ranchers' productivity, but they also displace grassland wildlife, like bobwhite quail and prairie chickens. Plus, redcedars steal precious water from streams and aquifers—each tree can consume

up to 40 gallons per day. Denser trees also cause hotter, more intense wildfires that threaten property and people.

## FIGHTING TREES WITH FIRE

Over two decades ago, Alberts and some of his neighbors decided to take action to save the grassland and their livelihoods. Some tried cutting redcedar with chainsaws or other machines, but it barely made a dent in the thicket. Instead, they turned to prescribed fire.

Grasslands evolved with frequent fires, which help recharge soil nutrients and spur new plants to grow. Historically, Nebraska's prairies burned every few years due to lightning strikes or Indigenous communities who lit fires to lure in bison and other game with fresh, green, post-burn grass. Without flames to relegate trees to wet or rocky areas, redcedars have inexorably marched across grasslands over the past 150 years.

Other landowners in the Great Plains were already using prescribed burns to prevent small saplings from becoming seed-dispersing trees. But the landowners in the Loess Canyons took it a step further—they decided to see if fire could restore rangeland after redcedars had already matured and spread.



Mark Alberts was the guinea pig. In 2000, a handful of other landowners and representatives from the NRCS helped him burn 300 acres. It worked like a charm, killing the trees and opening up his pasture. Alberts was able to run 10-15 percent more cattle when the grass grew back the following year.

But Alberts says that most of his neighbors “watched with clenched teeth,” including his uncle who lived across the fence. They were afraid the fire would get out of control, and doubted its ability to help rather than harm the land.

“What’s amazing is how nearly every one of those neighbors has come around,” Alberts said. “Even my uncle burned one of his pastures after seeing that the trees didn’t come back on my flats.”

## LOCAL LEADERS ARE KEY TO SUCCESS

Doug Whisenhunt, then a district conservationist with USDA’s Natural Resources Conservation Service (NRCS), helped orchestrate that first burn. A few years later, he helped Alberts and a dozen other landowners form the Loess Canyons Rangeland Alliance (LCRA), a group dedicated to using fire as a land management tool.

The LCRA now includes nearly 100 members who share equipment, time, and expertise to burn grasslands and keep trees at bay. Whisenhunt said a major turning point for motivating more

interest in prescribed fire was when Scott Stout, then in his mid-30s, took over as the burn boss and president of the LCRA.

“As a local rancher and social leader, he was the right guy to make it successful,” added Wisenhunt. “If your burn boss isn’t local, no one follows them—and you can’t be a leader if no one follows you.”

Participation and interest in prescribed fire grew so much that landowners formed a second burn group in 2008, the Central Platte Rangelands Alliance. Collectively, landowners in both groups have burned 135,000 acres in the Loess Canyons, which represents one-third of the total landscape.

“We’re all on the same page, trying to regain what we have lost. We trade labor and equipment back and forth, just like at a branding,” said Scott Stout, who is now president of the Nebraska Prescribed Fire Council. “It’s really brought back a sense of camaraderie among neighbors.”

Alberts reflected that “neighboring together better” is just one of the many benefits that came about as a result of reinstating fire.

## PARTNERS PONY UP TO SUPPORT LANDOWNERS

The nutritious new grasses that come in after a prescribed burn are also a boon to wildlife like songbirds, turkey, and deer. T.J. Walker is a

“At first, our goal was to get rid of cedars, but then we realized that burning has improved our grass structure, too. We’re getting more warm-season grasses, which are like steak and potatoes for cattle.” —Mark Alberts

## Improving Land & Livelihoods

wildlife biologist with Nebraska Game and Parks Commission who has worked with the Loess Canyons burn groups for over two decades. He stresses the importance of supporting landowner-led conservation since 97 percent of Nebraska is privately owned.

“We want to help the ranchers help themselves because their land provides a lot of great wildlife habitat,” said Walker. “If we aren’t managing the cedars, they’re going to take over those grasslands and drastically reduce biodiversity across the board.”



Christine Bielski

Walker credited the landowners and their commitment to each other as the main reason the Loess Canyons still have healthy, intact grasslands. But another not-so-secret ingredient to their success is strong partnerships between state and federal agencies and non-profits that provided landowners with financial and technical support.

The Nebraska Environmental Trust helped the LCRA purchase water tanks, drip torches, and all-terrain vehicles with sprayers. NRCS provides cost-share for landowners to defer grazing on the pastures they plan to burn. Pheasants

Forever, USFWS Partners for Fish and Wildlife, and Nebraska Game and Parks Commission also contribute funds to help landowners prepare burn units, which includes cutting isolated redcedars beforehand and “stuffing” them under dense cedar patches to provide fires with extra fuel for killing more mature trees. Using fire after cutting larger trees ensures that any seeds or small seedlings hidden in the grass are burned, which prevents a new generation of trees from rapidly re-encroaching.

Through good communication and the willingness to work together, these partners merged their efforts into one collective vision: restore healthy rangelands by removing invading eastern redcedar with prescribed fire.

## SCIENCE THAT’S PART OF THE FAMILY

The unique collaborative conservation work in the Loess Canyons drew the attention of Dirac Twidwell, a rangeland ecologist at the University of Nebraska-Lincoln.

“Most research is done on small experimental plots,” he said. “I was searching for examples of landowners using fire across properties and managing at larger scales to address woody encroachment.”

In 2014, Twidwell met with 20 ranchers at a steakhouse in Curtis, Nebraska, to see how researchers and landowners might learn from each other in the Loess Canyons. Landowners were so hungry for information that they talked with Twidwell for hours that night.

Following the meeting, Twidwell and the landowner group agreed to establish a private lands experimental landscape in the Loess Canyons covering approximately 180,000 acres.



"It's one of the largest experimental landscapes in Great Plains grasslands and one of the only ones owned entirely by private landowners," Twidwell explained.

Twidwell immediately took advantage of long-term monitoring data collected by NGPC and partners and implemented new field studies with graduate students. Since 2015, over a dozen students have collected data in the Loess Canyons Experimental Landscape. As evidence of the trust between scientists and ranchers, landowners even let students stay in their spare rooms or basements while they're conducting research over the summer.

"We often talk about scientific co-production or use-inspired science," said Twidwell. "This is a preeminent model of how to successfully work with landowners at large scales. It meets the land-grant mission of the University of Nebraska in the truest sense. We feel part of the family and the community. It's not just scientific conclusions. The science supports the cultural fabric of the region, and goes way beyond science produced solely from an ivory tower."

## IGNITING INTEREST WORLDWIDE

The community-based, co-production of science in the Loess Canyons includes the input and participation of groups like the Nebraska Game and Parks Commission.

"We don't want to do research in a vacuum, we want to do it in tandem with partners to give people the information they need to help manage the resource," said Walker.

Walker and his colleagues are now using models created by Twidwell's lab at the University of Nebraska-Lincoln to target grasslands conservation across the state. For instance, they



Christine Beilski

can identify areas most at risk from encroaching redcedar, as well as where to invest money to protect core habitat that is treeless.

Now that story is spreading far beyond Nebraska. Twidwell, Walker, and local landowners are mentoring resource managers who are struggling to contain trees taking over grasslands.

"This problem is worldwide," said Alberts. "People in Spain, Portugal, South Africa, they all want to know how we do it. They want us to teach them how to do prescribed burning safely to get back their grass and also to minimize the risk of catastrophic wildfires."

The science from the Loess Canyons also informed the first-ever, biome-scale framework for conservation action in the Great Plains, recently released by NRCS Working Lands for Wildlife. The aim is to clone the model of collaborative success in the Loess Canyons to help other landowners address threats in their region.

Meanwhile, Alberts, Stout, and hundreds of other landowners in the Loess Canyons—from great-grandparents down to young children—will continue to work side-by-side to use fire as a tool to improve their rangelands.

"I don't want my kids or grandkids to say, 'Why didn't Dad take care of those when he could?'" Stout said. "The time to get them is now."

**P**artnerships between landowners and scientists in the Loess Canyons have raised awareness of the threat of woody encroachment, promoted scientific innovation for proactive fire management, and have become examples of conservation success for others to

follow. Sharing these stories with other landowners and the public is an important component of scaling up these efforts to meet regional and biome-wide conservation goals. This section highlights the benefits of these partnerships through recent news coverage and headlines.



University of Nebraska

### NEBRASKA DRONE IS A REAL FIRESTARTER

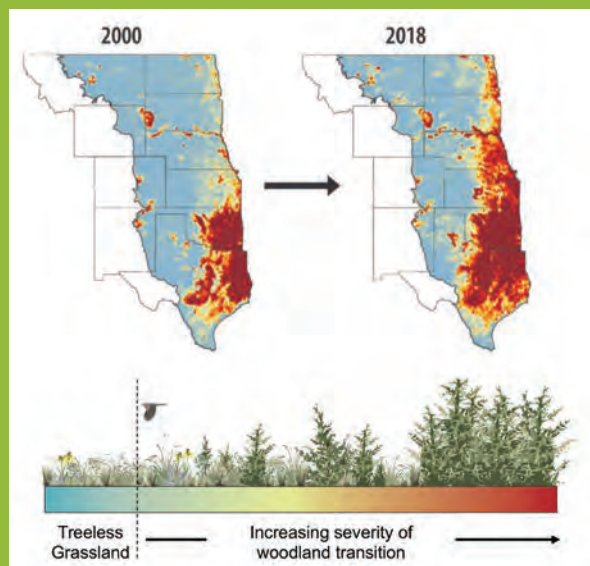
Fire-igniting drones first tested outdoors in the Loess Canyons, featured as an innovative technology in all the BIG 10 Conference's football, basketball, volleyball, and other sporting events. <https://btn.com/2016/11/05/watch-how-a-nebraska-team-created-a-drone-to-fight-wildfires-btn-livebig/>



## NATIONAL GEOGRAPHIC

### THE GREAT PLAINS PRAIRIE NEEDS FIRE

The Great Plains prairie needs fire to survive. These ranchers are bringing it back.



### NATIONAL GRASSLAND CONSERVATION DISCUSSION

"We're witnessing the death of a biome. It's actually pretty simple: Where there's fire, grass wins. Without fire, trees win.... The only documented example we have where management has stabilized large-scale grasslands is in the Loess Canyons, where landowners have rebuilt a regional fire culture to deal with the threat of woody encroachment. As we look to conserve other remaining prairie regions of the Great Plains, this will be a critical example to learn from." —Dirac Twidwell



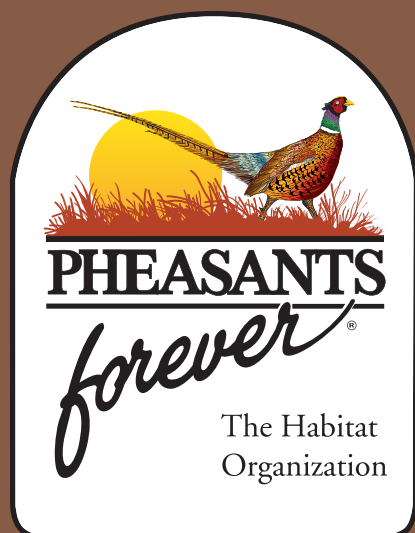
## THE SCIENCE BEHIND ERC INVASIONS

"Only one group in the Great Plains has demonstrated the capacity to stabilize a region following the onset of exponential growth of eastern redcedar. This is the result of unique partnership in the Loess Canyons of Nebraska, where landowners, scientists and agencies (Nebraska Game and Parks Commission, Pheasants Forever and Natural Resources Conservation Service) have leveraged resources in new ways to attempt to scale up ERC control, and this region provides the first scientific evidence for sustainable rangeland management in areas with higher amounts of eastern redcedar cover in the Great Plains." —*Dirac Twidwell*



## LOESS CANYONS ADD TO SCIENCE LITERACY

The Eastern Redcedar Science Literacy Project is the most comprehensive resource on eastern redcedar invasion and its impacts to human well-being, and it represents science-landowner partnerships at their most effective.



## PRESCRIBED FIRE CHANGING NE LANDSCAPE

In the fight against cedar encroachment, no state is taking a more aggressive approach than Nebraska where Pheasants Forever, Nebraska Game and Parks Commission, United States Department of Agriculture, Nebraska Environmental Trust, USFWS-Partners for Fish and Wildlife, The Nature Conservancy, University of Nebraska-Lincoln and others are forming prescribed burn associations throughout the state to take back the prairie. And, it's working. Just ask the folks who have helped reclaim nearly 250,000 acres from invasive red cedars over the past 15 years.

# Reducing Woody Encroachment in Grasslands

**A Guide for  
Understanding Risk and Vulnerability**

**E-1054**

**Oklahoma Cooperative Extension Service  
Division of Agricultural Sciences and Natural Resources  
Oklahoma State University**

## **NEW BEST MANAGEMENT GUIDELINES**

New solutions to woody encroachment have now been released as part of a multi-state extension effort, incorporating lessons learned from the Loess Canyons. Strategies that minimize risk and vulnerability are proven to more successfully sustain rangelands experiencing the threat of woody encroachment. This new guide helps managers develop a spatial game plan to reduce the economic burden of controlling woody encroachment, improve rancher profitability, and increase conservation outcomes.





## CONTROL CRITICAL TO RANGELAND HEALTH

"What redcedar control is accomplishing, is providing increased carrying/grazing capacity of pastures, increased access to land for management, maintenance and improvements; produced better rotational grazing management and other strategies. It has also increased income from the enterprise, helped the sustainability of family ranches (cattle and grass production) and provided support for rural town businesses and infrastructure." —*Dale Grotelueschen, DVM, Professor Emeritus (retired) past University of Nebraska Lincoln director of the Great Plains Veterinary Educational Center.*



NATURAL RESOURCES CONSERVATION SERVICE  
WORKING LANDS FOR WILDLIFE

## GREAT PLAINS GRASSLANDS BIOME

A FRAMEWORK FOR  
CONSERVATION ACTION

2021-2025

## LOESS CANYONS IS EXAMPLE TO FOLLOW

Loess Canyons featured as national example of success for others to follow in NRCS Working Lands for Wildlife's Framework for Conservation Action in the Great Plains Grassland Biome



## LANDOWNERS BAND TOGETHER

"Being successful has been, I think, the key to getting new members—people noticing what's going on. The landowners themselves have noticed healthier grass, improved soil health, increased wildlife habitat, and a rejuvenated water cycle—natural side effects of reintroducing fire to the landscape."

—*Tell Deatrich, Loess Canyons Rangeland Alliance member*

# Loess Canyons Landowners First to Halt Regional-Scale Transition Toward Woody Dominance

Dillon Fogarty, PhD Student



Erin McCready

Erin McCready

## MAJOR ISSUE

**W**oody plant encroachment by species like eastern redcedar is a serious threat to U.S. grasslands, with consequences that span from reductions in livestock production to loss of grassland biodiversity. Halting and reversing trends of woody encroachment are two key goals of working lands conservation. To date, such outcomes have been rare, and scientifically validated demonstrations of success are needed to better inform national conservation efforts.

## RESEARCH SUMMARY

The Loess Canyons ecoregion provides the first demonstration of success in halting a regional-scale transition towards woody dominance.

Assessment of management efforts in the Loess Canyons provides unique insights for scaling up conservation efforts in other working grasslands, including the important roles of prescribed fire, targeted management, collaboration across property lines, and landowner-agency-science partnerships.



## MAJOR FINDINGS

Research from the University of Nebraska showed the Loess Canyons ecoregion provides the first demonstration of successfully halting a regional-scale transition towards woody dominance. In response to woodland expansion, landowners in the Loess Canyons, with support from natural resource agencies, strategically ramped up conservation efforts and stabilized a regionally shrinking grassland ecosystem (Figure 1).

This assessment illustrated how agency support of collaborative, landowner-led management efforts plays a critical role in success. Landowners and managers in the Loess Canyons work across property lines and target all stages of the encroachment process using an integrated management approach where brush management is used to support large-scale prescribed fires.

Another critical component of the Loess Canyon's success is how large-scale management efforts focused on the boundaries between intact grasslands and areas where woody species were expanding into grasslands. When combined across the broader Loess Canyons landscape, these management treatments successfully halted woodland expansion.

## IMPLICATIONS

The Loess Canyons has emerged as a national example of conservation success in a working landscape. The work in this region provides key insights on scaling up grassland management, including the importance of prescribed fire, targeted management, landowner collaboration, and landowner-agency-science partnerships.

## FUNDING

Nebraska Game and Parks Commission (W-125-R-1), USDA Natural Resources Conservation Service and Pheasants Forever (PG18-62799-01 and SGI 2.0-19-06).

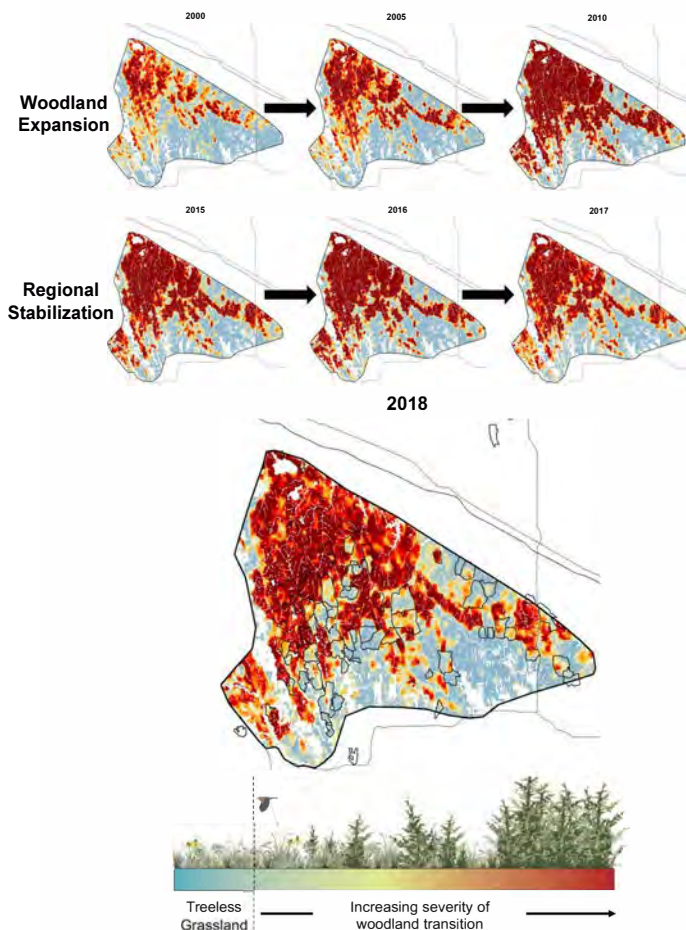


Figure 1. This 2018 map shows fire treatments (black polygons), and how management at the boundary halted regional expansion and the loss of large-scale grassland (in blue) to a regional woody state (in red).

# American Burying Beetle Shows Positive Responses to Fire Management

Alison Ludwig, Masters Student

Christine Bielski

## MAJOR ISSUE

**T**he threatened American burying beetle (ABB) is a Great Plains species negatively impacted by woody species like eastern redcedar. It remains uncertain what the impacts of high-intensity fire are on the ABB and its habitat preferences. Prescribed fire has become more widespread to combat woody encroachment in the Great Plains, including the Loess Canyons in central Nebraska. Prescribed fires in the Loess Canyons are of mixed intensities and include burns at high intensity that collapse woodlands.

## RESEARCH SUMMARY

Research from the Loess Canyons showed prescribed fire creates the ABB's preferred habitat without decreasing populations.

Woody encroachment in the range of ABB is a greater threat to their populations than prescribed fire, including high-intensity fires used for restoration. Future efforts to conserve and restore grassland using prescribed fire are expected to benefit ABB populations.



Alison Ludwig



## MAJOR FINDINGS

Research from the University of Nebraska showed the use of high-intensity fire did not negatively impact ABB populations; instead, these treatments produced additional grassland habitat preferred by the ABB. This research demonstrated the ABB has the strongest positive response to grassland cover when compared to other vegetation functional groups such as tree cover.

At 80 percent coverage of grassland plants, our results show as many as four ABB per trap. Conversely, ABB have a negative response to tree cover when it exceeds 10 percent of the landscape. When tree cover reaches 30 percent or more, our results found fewer than one ABB per trap.

## IMPLICATIONS

These findings outlined how continued woody encroachment is expected to have detrimental impacts on the ABB. However, the findings also show ongoing fire management has benefitted the ABB by halting trends of woody species encroachment and restoring preferred habitats. A key implication is that prescribed fire may be an important, and previously unrecognized practice, for conserving imperiled ABB populations.

## FUNDING

Nebraska Game and Parks Commission (W-125-R-1) and National Science Foundation.

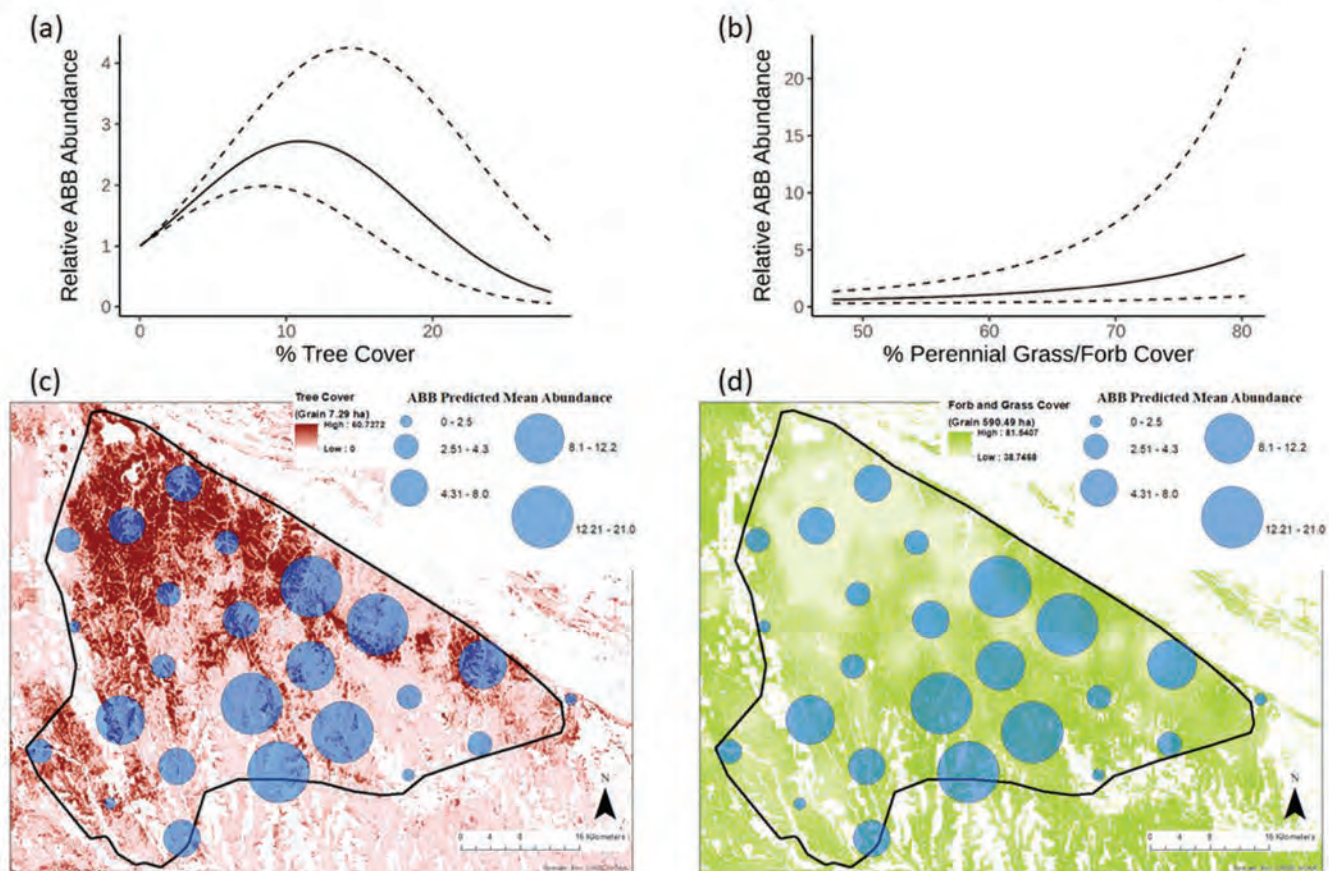


Figure 2. Eighty-seven percent of American burying beetles in the Loess Canyons occur in areas where fire management was implemented or where fire management prevented further grassland loss to woody transitions (as shown in Figure 1). Findings showed ABB are negatively associated with woody encroachment (left graphics), but they are able to thrive in grassland landscapes (right graphics).



# High-Intensity Prescribed Fires Restore Grassland Plant Diversity

Alison Ludwig, Masters Student



Christine Bielski



Erin McCready



## MAJOR ISSUE

In the Loess Canyons, land managers use localized high-intensity fires to collapse eastern redcedar woodlands to restore grasslands, yet the effects of this restoration practice on grassland species diversity are not well understood by the scientific community.

## RESEARCH SUMMARY

Woody encroachment is threatening native grassland communities across the Great Plains. Localized high-intensity fires are increasingly used to combat woody encroachment; however, their restoration efficacy regarding grassland plant diversity is not fully understood by scientists. In the Loess Canyons, localized high-intensity fire in eastern redcedar woodlands successfully restored grassland plant diversity and structure.

High-intensity fire restored herbaceous species richness and cover in burned eastern redcedar woodlands to levels similar to nearby grasslands, thereby demonstrating its effectiveness for grassland restoration.

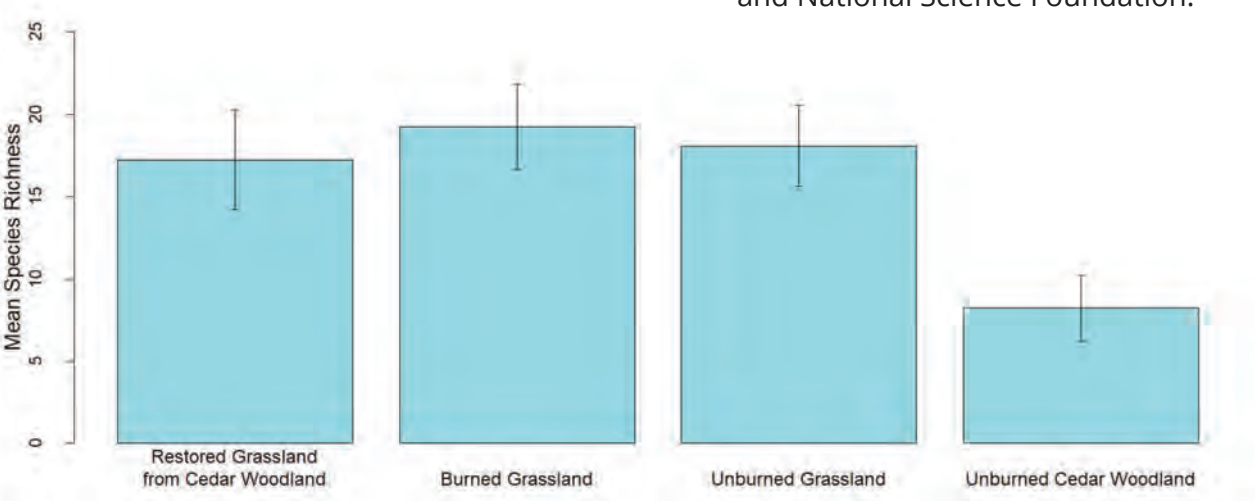


Figure 3. Species richness in restored grasslands is similar to burned and unburned grasslands, and is substantially different from unburned woodland controls.

## MAJOR FINDINGS

Woodland sites restored to grasslands through high-intensity fire had similar herbaceous plant species richness to nearby grassland sites across a time-since-fire gradient of 17 years. In contrast, woodland controls had the lowest herbaceous species richness.

Additionally, the percent herbaceous cover was similar between restored sites and grassland control sites, while woodland control sites had an extremely low percentage of herbaceous cover compared to all other sites.

## IMPLICATIONS

Herbaceous plant richness was less than half of grassland reference sites in stands of eastern redcedar, but high-intensity fires and high cedar mortality effectively restored plant species richness back to reference grassland plant communities.

## FUNDING

Nebraska Game and Parks Commission (W-125-R-1) and National Science Foundation.

# High-Intensity Prescribed Fires Collapse Eastern Redcedar and Restore Rangeland Productivity

Christine Bielski, Masters Student  
Rheinhardt Scholtz, Postdoctoral Researcher  
Victoria Donovan, Postdoctoral Researcher



Twidwell Lab

Erin McCready

## MAJOR ISSUE

**W**oody plant encroachment is a global problem threatening grassland distribution, biodiversity, and productivity. Understanding how to best restore grassland productivity through the use of prescribed fire is a key goal of land managers working to reverse the impacts of woody species encroachment. More than a decade of fires applied in the Loess Canyons provided a test case for examining the effects of high-intensity prescribed fires on grassland productivity.

## RESEARCH SUMMARY

High-intensity prescribed fire has been shown to reverse the trend of woody encroachment in grasslands. However, the results of such practices on grassland productivity are not well understood.

Restored grasslands produced 2,900 more pounds of forage per acre following collapse of eastern redcedar woodlands with high-intensity prescribed fire, similar to pre-encroachment levels.



High-intensity prescribed fire can be used to increase grassland productivity which benefits ranching-based economies and grassland-dependent wildlife.

## MAJOR FINDINGS

High-intensity fire restored herbaceous biomass, which translates to 2,900 pounds per acre more forage without eastern redcedar. One year after the application of high-intensity fires in eastern redcedar woodlands, mean total herbaceous biomass was consistently higher than in unburned eastern redcedar woodlands. Additionally, herbaceous biomass in the restored sites was similar to or higher than that seen in nearby grasslands. These levels of herbaceous biomass persisted after high-intensity fire treatment for at least 15 years post treatment (Figure 4).

## IMPLICATIONS

While prior studies have shown that low-intensity fires cannot completely reverse woody species encroachment into grasslands, this assessment showed eastern redcedar encroachment is reversible using the high-intensity fire applied by landowners in the Loess Canyons. These techniques can be used to restore grassland biomass, and commensurate productivity, in grassland systems that have transitioned to woodlands.

## FUNDING

Nebraska Game and Parks Commission (W-125-R-1) and Joint Fire Science Program.

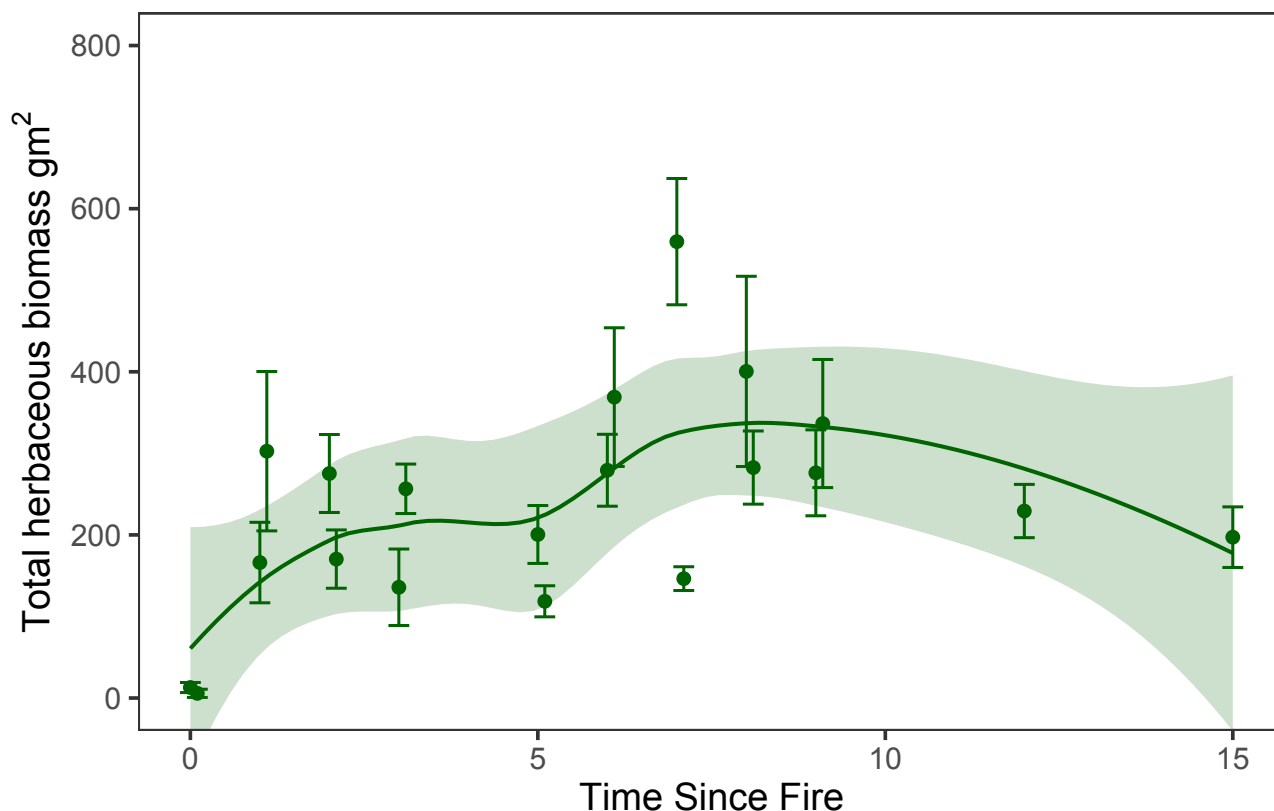


Figure 4. Restoration of herbaceous biomass production following high-intensity burning in eastern redcedar woodlands, representing a 2,900-pound-per-acre increase in forage without eastern redcedar.

# Prescribed Burning Restores Grassland Bird Richness in the Loess Canyons



Caleb Roberts, Postdoctoral Researcher\*

\*Current affiliation: Assistant Unit  
Leader, US Geological Survey,  
Arkansas Cooperative Fish &  
Wildlife Research Unit

Gregory Smith

## MAJOR ISSUE

**S**ince 1970, more than 700 million grassland breeding birds have been lost in North America. Halting and reversing this trend has been a key focus of grassland conservation. However, there are few examples of how this can be accomplished at the scale needed.

## RESEARCH SUMMARY

Research showed prescribed burning in the Loess Canyons provides a promising example of large-scale restoration for grassland bird populations and species diversity.



Caleb Roberts



The number of grassland bird species increased across 65 percent of the Loess Canyons, representing gains that would not have been expected without large-scale fire management. Fire managers were able to strategically halt regional woodland expansion, while also building upon remaining grassland networks to bolster grassland bird species.

The Loess Canyons ecoregion provides a key example of how targeted management of woody encroachment can be used to benefit grassland bird populations.

## KEY FINDINGS

Research from the University of Nebraska showed prescribed burning in the Loess Canyons was able to halt woody species encroachment, corresponding to increases in the number of grassland bird species across 65 percent of the Loess Canyons.

In the same landscape, areas with a declining number of grassland bird species tended to be eastern redcedar dominated and lacked fire management, suggesting that these gains would not have been expected without large-scale fire management. Further, had woody encroachment continued unabated, the region would have likely experienced additional declines in the number of grassland bird species.

## IMPLICATIONS

Reversing biome-wide impacts of woody encroachment on grassland birds will require targeted efforts, where landowners, agencies, and scientists work together. Land managers in the Loess Canyons demonstrated how this is possible at the regional scale through a unified vision for rangeland conservation that benefits both ranching and biodiversity outcomes.

## FUNDING

Nebraska Game and Parks Commission (W-125-R-1) and Department of Defense SERDP.

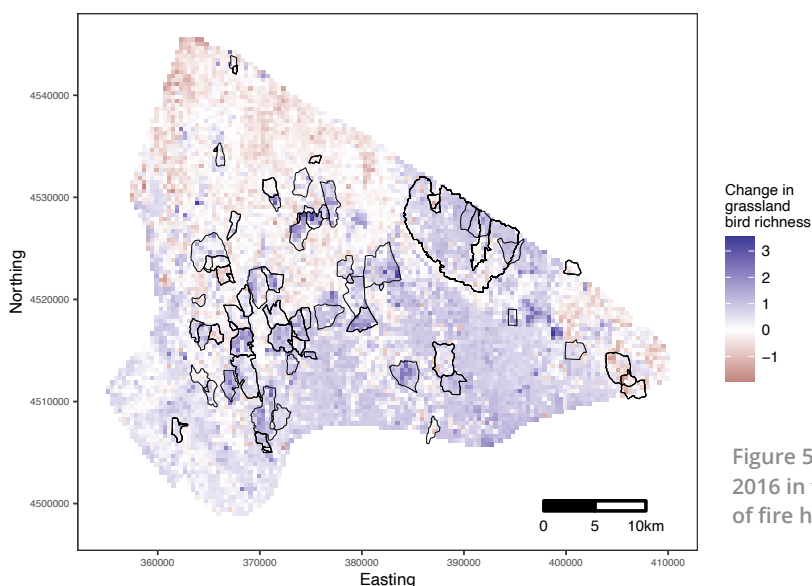


Figure 5. Change in the number of grassland birds from 2010 to 2016 in the Loess Canyons. Black polygons show a reconstruction of fire history associated with benefits to grassland birds.

# Prescribed Burning Reduces Wildfire Risk in the Loess Canyons

Victoria Donovan, Postdoctoral Researcher

Christine Bielski

## MAJOR ISSUE

**P**revious studies that showed links between woody encroachment and an increased risk of large wildfire highlight the need to better understand how prescribed burning can reduce the risk of wildfire as grasslands transition to woodlands. One key concern for fire managers and wildfire suppression efforts is spot fire. Spot fires are fires that start outside of the original fire perimeter through lofted sparks and fire brands. As potential spot fire distances increase, so does the risk of wildfire. In this study, researchers from the University of Nebraska used the Loess Canyons as a model landscape to examine the potential for prescribed burning to reduce spot fire distance at various stages of the encroachment process.

## RESEARCH SUMMARY

Links between volatile fuels from woody encroachment and large wildfires highlight the need to better understand the potential for using prescribed burning as a wildfire risk reduction tactic.

In this study, fire behavior models were used to demonstrate the potential for prescribed burning to reduce spot fire distance, a key component of wildfire risk.



Victoria Donovan



Using the Loess Canyons as a model landscape, the results demonstrate how prescribed burning can reduce the risk of wildfire across all stages of the encroachment process.

## RESEARCH FINDINGS

Fire behavior models demonstrated woody encroachment increased the potential spot fire distance with woodlands having the longest spot fire distances compared to encroached and un-encroached grasslands. These differences in spot fire distance became more pronounced at greater wind speeds. However, in all cases, spot fire distances were substantially lower under prescribed burning conditions compared to more extreme conditions only seen during wildfire events (Figure 6). In some of the most extreme comparisons, potential spot fire distance was more than three miles lower under prescribed burning conditions compared to wildfire conditions.

## IMPLICATIONS

Removing fire from grasslands is impossible, as demonstrated by increasing wildfire frequency in the Great Plains associated with woody encroachment. Findings from this study demonstrate multiple ways in which prescribed burning can reduce the risk of spot fire and the costs associated with fire containment: 1) Prescribed burning reduces potential spot fire distance, regardless of the encroachment stage. 2) Proactive prescribed burning prevents the build up of more volatile woody species associated with greater spot fire risk. 3) Prescribed burning can reverse woody encroachment, thereby decreasing future spot fire risk. The Loess Canyons is an ideal landscape to demonstrate how to reduce wildfire risk because each of these examples occur in this landscape.

## FUNDING

Nebraska Game and Parks Commission  
(W-125-R-1)

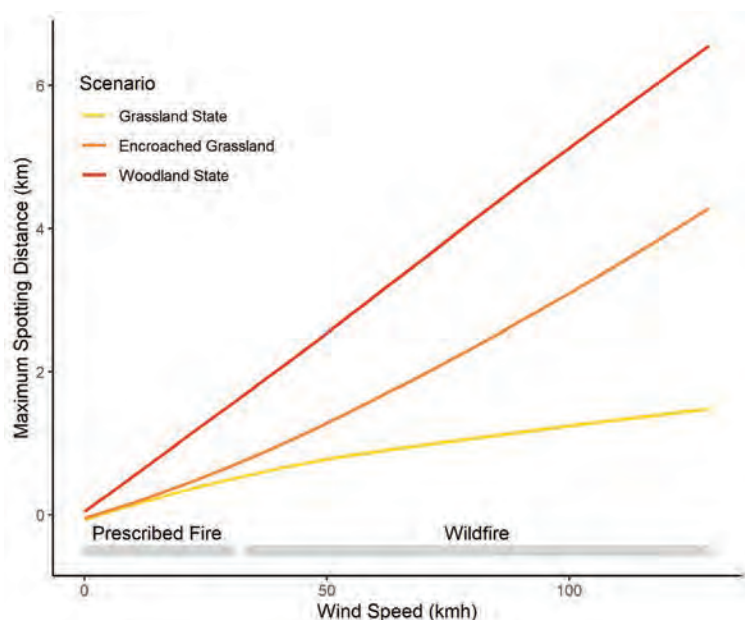


Figure 6. Potential spot fire distance is substantially lower under prescribed fire conditions compared to more extreme wind speed conditions that only occur during wildfires. Eastern redcedar encroachment greatly increases spot fire distance and potential for new wildfires to start and spread.

# Closing Remarks

Christine Bielski

**T**he steep hills and sea of mixed-grass prairie in the Loess Canyons owe much of their vitality and productivity to fire—a vital force that has shaped grasslands for millennia, and one that landowners have proudly reinstated in southwestern Nebraska.

By embracing prescribed fire, these motivated landowners have turned the tide on invading eastern redcedar trees. The spread of trees onto grasslands is a problem worldwide: woody species push out native wildlife, decrease the amount of livestock forage, disrupt water resources, and increase wildlife danger.

Research from the Loess Canyons shows fire management can flip the script on the threats posed by encroaching trees. This experimental landscape provides the first scientific evidence that fires can stabilize a region undergoing rapid losses due to woody encroachment, restore productive rangelands, and improve wildlife habitat and other ecosystem services. The ongoing, real-world findings from this landscape will continue to be the scientific foundation for rangeland conservation efforts across the Great Plains. More broadly, this story epitomizes new national grassland conservation efforts, such as

the new Great Plains biome framework ([wlfw.rangelands.app](https://wlfw.rangelands.app)) managed by the USDA Natural Resources Conservation Services's Working Lands for Wildlife (WLFW) with its call to act now to address the threat of woody encroachment.

The shared trust and vision of landowners in the Loess Canyons has allowed us to strike a balance between research that is scientifically rigorous, practical for agricultural producers, and useful for learning how to improve on-the-ground practices. Importantly, the science shows not only the strengths of the conservation work underway in the Loess Canyons, but also weaknesses where resource managers can improve in the future. By aligning landowner vision with scientific research and agency resources, communities can win against biome-scale threats like woody encroachment.

We hope this story of fire-driven, locally led conservation and its outcomes will inspire future generations in the Loess Canyons to continue the legacy that has now been established. Elsewhere, our aim is to motivate and establish new large-scale partnerships that strive to conserve the nation's remaining iconic grasslands.





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Eric Fowler



Christine Bielski



Christine Bielski



Andy Moore



Andy Moore