RWFM-PU-410
June 2023

THE NEW WILDFIRE SEASON

Deann Burson[1], Victoria Donovan[2], Carol Baldwin[3], Pete Bauman[4], Morgan Treadwell[5], Dirac Twidwell[6], John Weir[7], and Carissa L. Wonkka[8]

INTRODUCTION

Extreme wildfire events result in considerable economic, environmental, and agricultural losses yearly in the United States. The financial burden, regional impact, and seasonal length of wildfires have significantly expanded in recent decades, causing national and global concerns. Annual records dating back to 1983 indicate that three of the five largest wildfire years for acreage burned in the United States have occurred since 2015 (2015, 2017, and 2020, respectively) (National Interagency Fire Center [NIFC], 2021a). Changing weather patterns, human activity, and the ever-growing number of people moving into rural lands have increased wildfire risks and resulted in an extended wildfire season. As the threat of wildfires escalates, so do potential consequences to landowners in the North American Great Plains. Of the major wildfire events in the continental United States between 1984 to 2019, up to 95 percent of these included some rangelands, and 54 percent occurred primarily in rangelands (Donovan, n.d.).

Changing climate patterns have increased the incidence of warm, dry conditions favorable to dangerous and unpredictable wildfire behavior. Extended dry periods, droughts, and increased lightning frequency are becoming more common with more and longer periods of elevated temperatures that dry vegetation and increase the probability of ignition. While lightning-started wildfires comprise a portion of wildfires each year, particularly in the mountainous western states, human ignitions (e.g., negligence, electrical, burning debris, etc.) are the leading contributors to recent shifts in wildfire activity. Human-caused fires accounted for 86 percent of all wildfires occurring over the 21 years between 2001 to 2021 (NIFC, 2021a) and have a significantly longer season than lightning-caused fires. The Great Plains has experienced the most significant increase in human-related wildfire events of any United States ecoregion (Balch et al., 2017). As people and infrastructure rapidly expand into rural landscapes, wildfire impacts increase due to the extended length of the fire season and the growing expanse of wildfire-affected acres.

WILDLAND-URBAN INTERFACE

The wildland-urban interface (WUI) is a term used to describe an area or zone where human development intersects unoccupied lands, often characterized by vegetative fuels. The potential for structure ignition further complicates wildfire relief efforts in the WUI. It is a major concern as working lands rapidly become fragmented and converted to non-agricultural uses. Texas is currently ranked second in the nation in the number of houses in the WUI, only behind California (United States Fire Administration, 2022), and Texas led the nation in population growth from 2000 to 2019 (United States Census Bureau, 2022). *Texas Land Trends* is a decision-support website that can be used to monitor land use, value, and ownership trends to assist in strategic planning for WUI expansion based on current trends and develop wildfire mitigation approaches.

[1] Ph.D. Student, Department of Rangeland, Wildlife & Fisheries Management, Texas A&M University

[2] Assistant Professor of Forest Management, School of Forest, Fisheries, and Geomatics Sciences, University of Florida IFAS

[3] Carol Baldwin, Kansas State University

[4] Pete Bauman, Extension Natural Resources and Wildlife Field Specialist, Department of Natural Resource Management, South Dakota State University

[5] Morgan Treadwell, Associate Professor and Range Extension Specialist, Department of Rangeland, Wildlife, & Fisheries Management, Texas A&M AgriLife Extension Service

[6] Dirac Twidwell, Professor, University of Nebraska

[7] John Weir, Associate Extension Specialist, Department of Natural Resource Ecology and Management, Oklahoma State University

[8] Carissa L. Wonkka, Research Ecologist, USDA ARS Northern Plains Agricultural Research Lab

Other Great Plains states with large growth in the WUI include New Mexico, with one of the highest percentages of homes in WUI areas compared to the total homes in the state, and Oklahoma, where about 40 percent of the state's total population now lives in the WUI. Colorado and Nebraska have also seen recent rises in WUI-related incidents.

HUMAN-CAUSED WILDFIRES EXTEND THE TIME AND AREA BURNED

Human-caused fires in the United States are estimated to extend the fire season by over 3 months, especially in the spring, while changing weather patterns have only expanded the fire weather season by a few weeks (Abatzoglou & Williams, 2016; Jolly et al., 2015). Findings show that human-caused wildfires can ignite under higher fuel moisture conditions than lightning-started fires, and they occur less predictably than lightning ignitions, which show a strong seasonal pattern. Most lightning fires ignite during the summer when vegetation is drier and the weather is likelier to favor stormy conditions capable of producing lightning. Compared to the 78 percent of lightning-induced fire events that are sparked in the summer, 76 percent of human-started wildfires occur in the spring, fall, and winter (Balch et al., 2017). Although human-driven fires tend to be smaller and less intense, they extend the wildfire season throughout the year, presenting new challenges to wildland firefighters and landowners.

The longer wildfire season and expanding rural infrastructure that needs to be defended from wildfire are increasing pressure on the already-stretched resources of volunteer fire departments (VFDs), which are primarily responsible for wildfire suppression in the Great Plains. The possibility of direct attack during initial suppression efforts is dangerous, and most often, local resources are easily overwhelmed by intense, immediate fire behavior resulting in more expensive wildfire suppression via indirect attack and aerial support.

The geographic distribution of wildfires varies between human and lightning-started wildfires. At the state level, human-started fires in Texas accounted for 95 percent of wildfire ignitions and 78 percent of the total area burned by wildfires between 1992 and 2012 (Balch et al., 2017). Cultural drivers like roadway networks, densely populated urban areas, and land-use patterns strongly affect human wildfire ignitions and frequencies. Population growth in the Great Plains, particularly in vulnerable ecosystems where woody vegetation and houses intermingle, has increased the likelihood of human-driven wildfire activity. As development increases and the WUI expands, fires are expected to play an increasing role in traditionally low-risk areas. In contrast, local topography and climate are the main variables driving lightning-related wildfires.

INCREASED FIRE ACTIVITY IN THE GREAT PLAINS

Humans significantly affect multiple ecosystem processes, including fire frequency. Euro-American settlement in the Great Plains led to widespread fire suppression in a grassland ecosystem that was previously one of North America's most frequently burned landscapes. Urbanization, agricultural fields, land fragmentation, and social influences over the last century have drastically altered the fire regime so that large wildfires have been almost absent in the ecoregion. Years of wildfire suppression, combined with ecological and climatic changes in the Great Plains, have rapidly led to recent shifts in wildfire potential (Fig. 1). Recent analysis indicates that in the 30 years

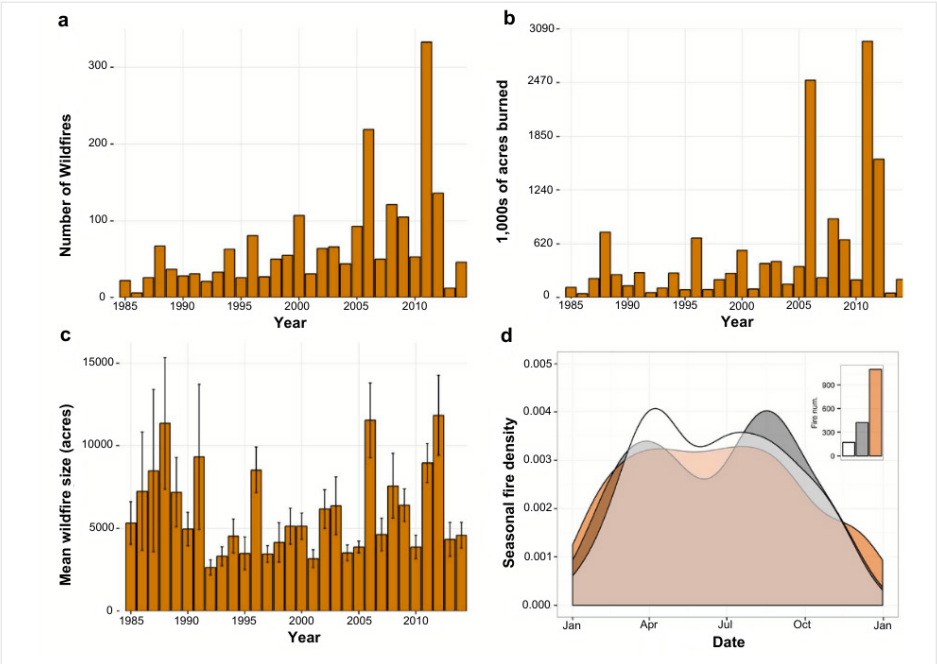

Figure 1. (a) The annual total number of large wildfires in the Great Plains from 1985 to 2014. (b) The total area (thousands of acres) burned in large wildfires in the Great Plains from 1985 to 2014. (c) The average size (acres) of wildfires in the Great Plains from 1985 to 2014. Error bars represent standard error. (d) Seasonal distribution of large wildfires per decade in each Great Plains ecoregion. *Altered from Donovan et al., 2017.*

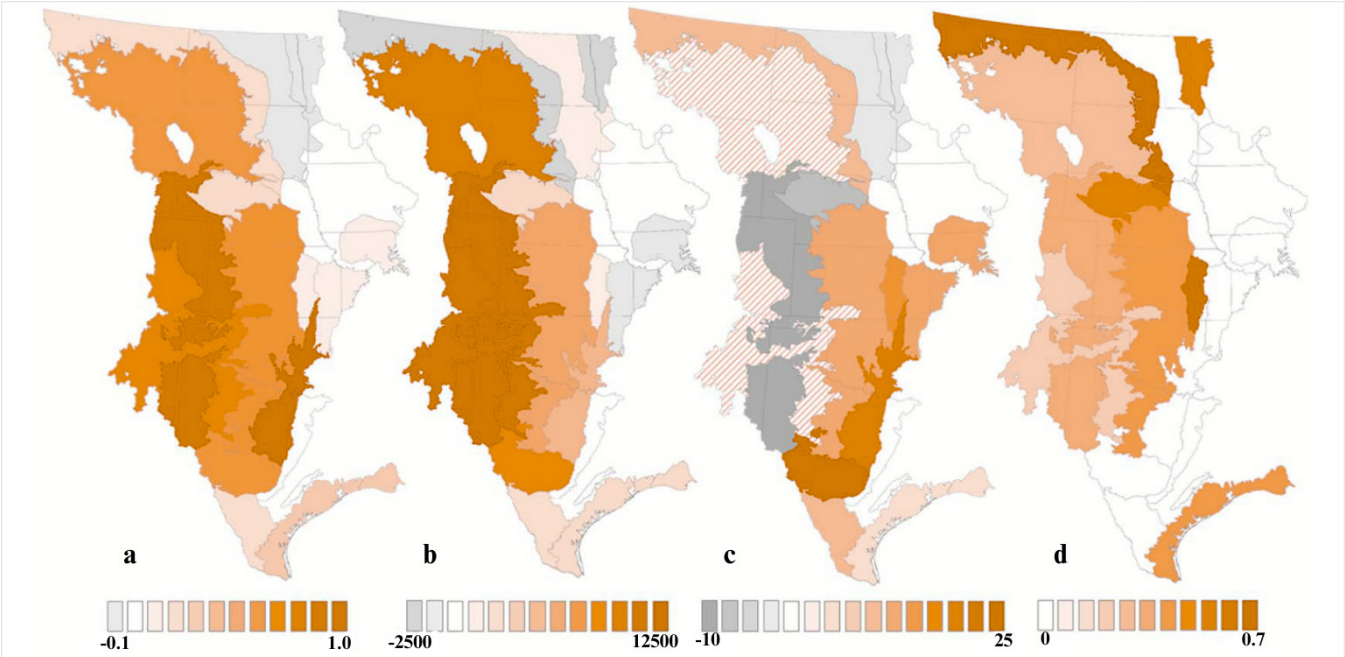

Figure 2. (a) Relative rate of change in the total number of wildfires from 1985 to 2014. (b) Relative rate of change in the total acreage burned by wildfires from 1985 to 2014. (c) Change in the probability of a large wildfire occurring from 1985 to 2014. Areas marked with hatching indicate that large wildfires occur every year. (d) Variation in wildfire seasonality from 1985 to 1994 compared to 2004 to 2014. *Altered from Donovan et al., 2017.*

between 1985 to 2014, the Great Plains experienced a 400 percent increase in the total acreage burned by large wildfires. Additionally, the average number of large wildfire events in the biome increased from an average of about 33 per year from 1985 to 1994 to nearly 117 from 2005 to 2014 (Donovan et al., 2017). The southern and west-central regions of the Great Plains have been especially affected by increasing wildfire numbers and acreage burned (Figs. 2a and 2b), and southeastern portions of the biome have experienced increasing chances of large wildfires occurring in recent decades (Fig. 2c). Although wildfire seasonality has not varied much in the entire biome since 1984 (Fig. 1d), at an ecoregional level, seasonal variations in wildfires have occurred in northeastern and central areas (Fig. 3).

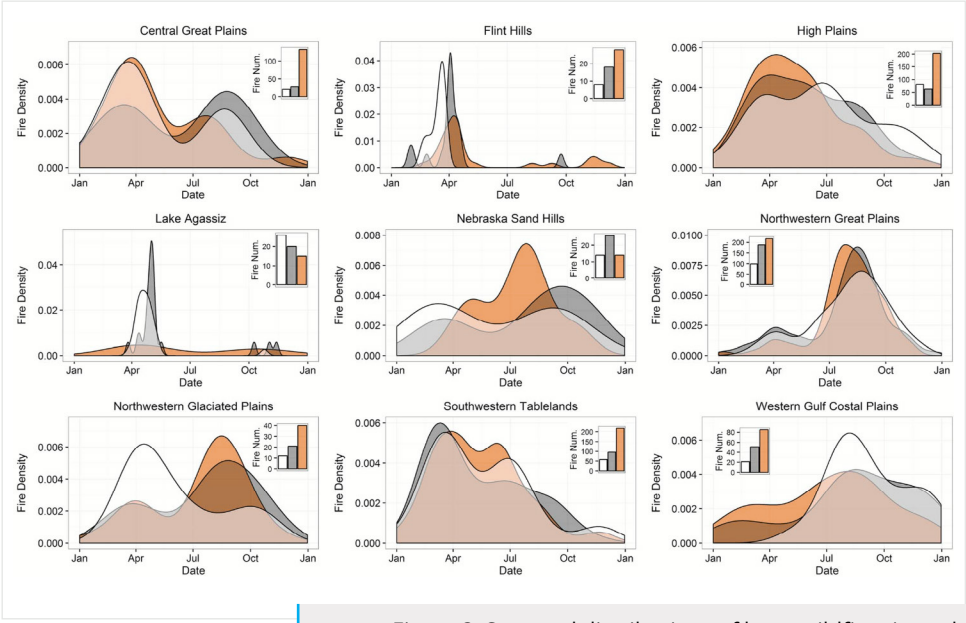

Figure 3. Seasonal distributions of large wildfires in each decade for ecoregions with more than five wildfires per decade. *Altered from Donovan et al., 2017.*

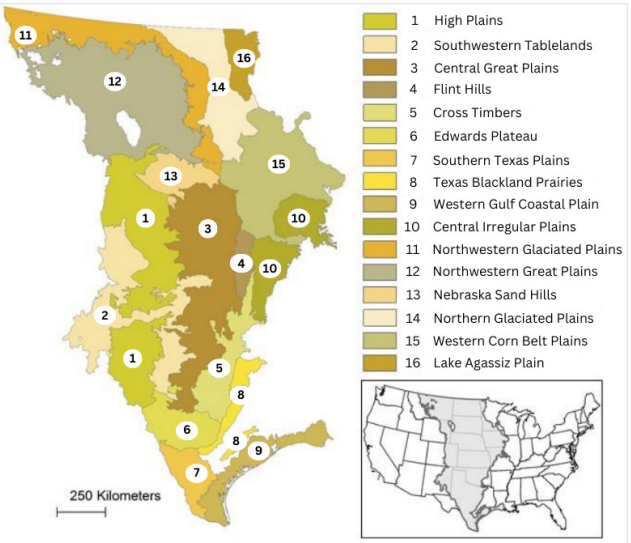

Figure 4. Great Plains L3 ecoregions designated by the United States Environmental Protection Agency. *Altered from Donovan et al., 2017.*

All ecoregions used in this analysis were designated according to the United States Environmental Protection Agency (EPA) (Fig. 4).

Proactively addressing dynamic vegetation shifts in the Great Plains should be a top management priority for mitigating the probability of future large wildfire events. Woody plant encroachment is linked to the recent increase in large wildfire activity in the Great Plains, with large wildfires occurring more frequently in landscapes consisting of more than 20 percent woody cover (Donovan et al., 2020). Further, invasive annual grass species can promote wildfire probability and frequency (Fusco et al., 2019). Emerging strategies are currently focused on the preemptive dedication to defend and grow core rangeland areas consisting primarily of intact, native grasslands.

This preventative approach capitalizes on identifying, maintaining, and expanding key conservation areas least vulnerable to invasive woody and grass species. Healthy rangelands should be the top priority for management efforts, emphasizing early detection and maintenance. Restoration precedence then follows with a spectrum of ecological states from seedling recruitment to degraded conditions. Landowner awareness of the spectrum of transitions on their lands is crucial to reducing wildfire risk. As rangelands are introduced to invasive species, they become increasingly susceptible to further invasions and require significantly more resources to manage. In the many areas of the Great Plains that have already transitioned to closed-canopy states, fire break establishment and targeted grazing to reduce the extent of wildfires may be more feasible than restoration efforts.

ECONOMICS

Wildfire events can economically devastate communities. Billions of dollars are spent annually fighting wildfires in the United States. The annual cost of federal wildfire suppression exceeded 4 billion dollars in 2021—a greater than 210 percent growth since 2000 (Fig. 5) (NIFC, 2021b). The total economic impact of wildfire suppression on communities and infrastructure would far surpass this number. The financial losses from wildfires are especially detrimental to farmers and ranchers in the Great Plains. Texas A&M AgriLife Extension economists estimated $23.1 million in preliminary agricultural losses resulting from March 2022 wildfire events in Texas that burned 433,000 acres and killed over 400 head of livestock (Fannin, 2022). Likewise, an April 2018 wildfire burned 350,000 acres in northwest Oklahoma, killing 1,600 head of cattle (Bechtel, 2018).

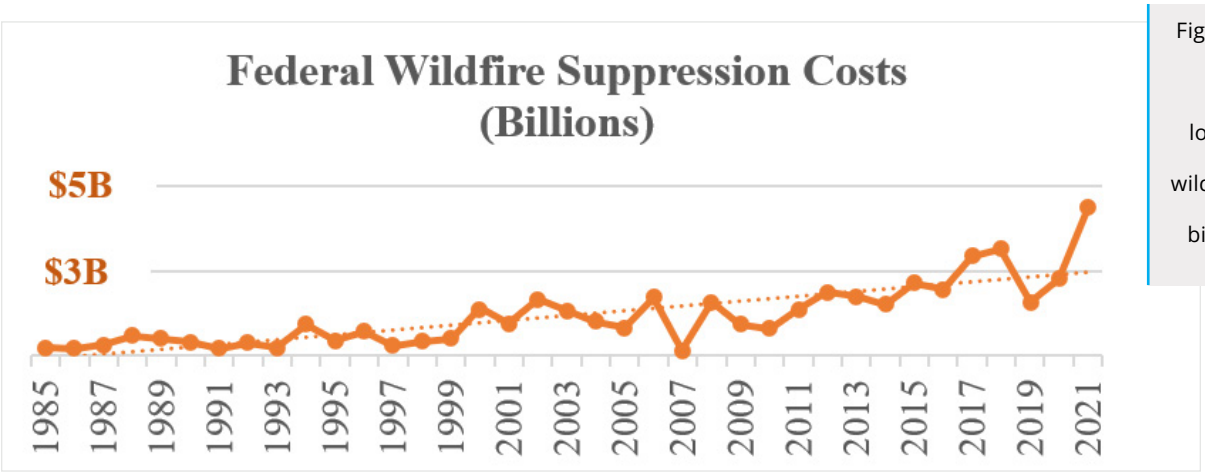

Figure 5. Studies suggest that the range of economic losses annually generated by wildfire damages is $37 to $88 billion (Thomas et al., 2017).

BUILDING FIRE-RESILIENT COMMUNITIES

Rural areas often rely on VFDs, and funding, equipment, and trained personnel are frequently insufficient for adequate wildfire suppression. Although the Great Plains comprises nearly one-third of the land area in the United States, most federal funds and resources are allocated toward wildfire suppression in the forested regions in the western United States (United States Department of Agriculture, 2010). In the face of increased wildfire activity, communities in the Great Plains must be proactive. The employment of additional local resources and labor, such as assets used in prescribed burn associations (PBAs), may effectively be integrated into VFDs and could become crucial when property and lives are threatened in a major wildfire. PBAs are locally organized, landowner-driven cooperatives that take a neighbor-helping-neighbor approach to getting prescribed fire on the ground. PBAs combine experience, manpower, and equipment to implement prescribed fire as a management tool. By working together, PBAs reduce prescribed fire's financial and liability risks while increasing efficiency and community engagement. The fire knowledge PBA members gain in prescribed fire applications often makes them well-qualified to assist with wildfire suppression.

CLIMATE-SMART AGRICULTURE

Climate change impacts virtually all natural resources and complicates wildfire threats in the Great Plains. As climate and weather patterns continue to change, so must producers and land managers. Recognizing and improving adaptive management practices during variable and extreme climatic shifts is critical for landowners susceptible to wildfire threats, especially agricultural enterprises, because of their direct role in the global water, energy, and food supply. Climate-smart agriculture is a concept involving the integrated approach toward managing landscapes to increase natural resources' sustainability, productivity, and resilience in the face of environmental and climate change factors. With climate-smart agricultural practices, fire and grazing work together to maintain open spaces on rangelands and influence plant succession and wildfire resiliency.

The development of fire-adapted landscapes supports climate-smart agricultural principles. Fire-smart management practices, like prescribed fire, enable communities to mitigate fuel loads safely and effectively to enhance the landscape's natural resilience to extreme wildfire events. In addition to hazardous fuel reduction, prescribed fire can increase plant vigor and biodiversity. Targeted livestock grazing can also be used as another climate-smart tool to reduce wildfire risk. Proper grazing management diminishes fuel loads as livestock selectively consume and reduce biomass. Cattle grazing alters plant community structure by shortening plant height and creating disconnected patches of fine, flashy fuels, limiting fire spread. Due to their browsing preferences, goats are among the most suitable livestock species for fuel reduction because they preferentially browse woody plant species that are potentially volatile fuel loads. After a fire, goat preference for palatable regrowth may also assist in the continued suppression of woody plants. Although targeted livestock grazing can complement fire and may be preferable in the WUI because of its aesthetic and social appeal, it is not a substitute for prescribed fire or other fuel treatments, especially in areas with moderate to high tree densities.

In addition to woody fuels, invasive grasses have been implicated in altering fire regimes in many Great Plains systems. In areas where fire frequency or intensity is enhanced by the transitioning of native communities to invasive grass-dominated communities, invasive grass management can reduce fire behavior and enhance suppression capacity during wildfires. Climate-smart agriculture should include a management plan for invasive herbaceous plants that alter fuel properties, as well as invasive woody plants. Failing to manage woody encroachment and annual grass invasions is not climate-smart. Both have altered fire regimes and increased the threat of natural disasters across many Great Plains systems. Wildfire danger is becoming worse in the Great Plains due to the expansion of volatile woody fuels, which is also implicated in the degradation of water quality and quantity, whereas invasions of annual invasive grasses are increasing the frequency of wildfire occurrence and wildfire intensity. Along with prescribed burning, other climate-smart agricultural practices, like mechanical brush management and herbaceous weed spraying, should be part of a long-term, integrated management plan to reduce vulnerability to invasions by woody plants and annual grasses.

CONCLUSION

As human ignition pressure increases, wildfires are becoming more frequent and expanding seasonally and spatially. The Great Plains ecoregion is particularly vulnerable to these extended wildfire risks. Obtaining adequate resources to effectively suppress wildfires will likely be a challenge for the Great Plains states moving forward because they may be less equipped to handle the increase in wildfire activity than historically at-risk regions. A future with wildfire is inevitable, but with long-term, strategic planning, the extent to which wildfires and subsequent damages occur can be lessened. Tactical solutions, including national and regional policy interventions, must be developed in the Great Plains to achieve a more sustainable coexistence with fire.

REFERENCES

Abatzoglou, J. T., & Williams, A. P. (2016). Impact of anthropogenic climate change on wildfire across western US forests. *Proceedings of the National Academy of Sciences*, 113(42), 11770–11775.

Balch, J. K., Bradley, B. A., Abatzoglou, J. T., Nagy, R. C., Fusco, E. J., & Mahood, A. L. (2017). Human-started wildfires expand the fire niche across the United States. *Proceedings of the National Academy of Sciences*, 114(11), 2946–2951.

Bechtel, W. (2018). *Oklahoma wildfires cause $26 million in damages for cattle ranchers*. Drovers. https://www.drovers.com/news-weather/oklahoma-wildfires-cause-26-million-damages-cattle-ranchers

Donovan, V. M. (n.d.). *The majority of U.S. large wildfires burn in rangelands*. [Manuscript in preparation].

Donovan, V. M., Wonkka, C. L. & Twidwell, D. (2017). Surging wildfire activity in a grassland biome. *Geophysical Research Letters*, 44(12), 5986–5993.

Donovan, V. M., Wonkka, C. L., Wedin, D. A. & Twidwell, D. (2020). Land-use type as a driver of large wildfire occurrence in the U.S. Great Plains. Remote Sensing, 12(11), 1869.

Fannin, B. (2022). *Preliminary agriculture losses from Texas wildfires total $23.1 Million*. Texas A&M Today. https://today.tamu.edu/2022/05/11/preliminary-agriculture-losses-from-texas-wildfires-total-23-1-million/

Fusco, E. J., Finn, J. T., Balch, J. K., Nagy, R. C., & Bradley, B. A. (2019). Invasive grasses increase fire occurrence and frequency across US ecoregions. *Proceedings of the National Academy of Sciences*, 116(47), 23594–23599.

Jolly, W. M., Cochrane, M. A., Freeborn, P. H., Holden, Z. A., Brown, T. J., Williamson, G. J., & Bowman, D. M. (2015). Climate-induced variations in global wildfire danger from 1979 to 2013. *Nature Communications*, 6(1), 7537.

National Interagency Fire Center. (2021a). *Total wildland fires and acres (1960–2021) and current year-to-date by state*. National Interagency Fire Center Statistics. https://www.nifc.gov/

National Interagency Fire Center. (2021b). *Federal firefighting costs (suppression only)*. National Interagency Fire Center Statistics. https://www.nifc.gov/

Thomas, D., Butry, D., Gilbert, S., Webb, D., & Fung, J. 2017. The costs and losses of wildfires. *NIST Special Publication*, 1215(11).

United States Census Bureau. (2022). *Growth in U.S. population shows early indication of recovery amid COVID-19 pandemic*. https://www.census.gov/newsroom/press-releases/2022/2022-population-estimates.html

United States Department of Agriculture. (2010). *Fire and aviation management fiscal year 2009 accountability report*. USDA Forest Service. https://www.forestsandrangelands.gov/documents/resources/reports/2009/FY2009FAMAccountabilityReport.pdf

United States Fire Administration. (2022). *What is the WUI?* Federal Emergency Management Agency. https://www.usfa.fema.gov/wui/what-is-the-wui.html