Grasslands in Peril? The Relationship Between Wildfire and Annual Grasses

Rebecca Kurnick & Stuart Jennings

## The Issue Today

Wildfires around the world are changing. We are seeing more frequent burns of higher intensity than historical fire regimes have revealed. These changes are largely a result of changes in temperature and precipitation shifting to hotter and dryer patterns due to climate change. According to the latest IPCC report "fire risks have increased due to heat and drought conditions in many parts of the world". Major influences of these changes in the western United States are a dramatic shift in vegetation composition. Mismanagement of land under hotter, dryer conditions has led to aggressive establishment of annual weeds and grasses that outcompete perennial vegetation that previously dominated the landscape. "Regional increases in area burned by wildfires (up to double natural levels) have been attributed to anthropogenic climate change in tropical, temperate and boreal ecosystems around the world, damaging key aspects of ecological integrity" (IPCC 6 North America fact sheet).

## Grasslands and Shifting Plant Populations

Grasslands are a globally imperiled biome. Known as steppes, prairies, savannas, and rangelands these perennial grass-dominated landforms cover nearly 30 percent of the land area of the planet. Grasses of the family Poaceae evolved over millions of years where our ancestors hunted endemic grassland wildlife. The economic importance of grasses to humans is almost impossible to overestimate (Boufford, 1993). Gone are the nomadic lifestyles of hunters and herders that have been replaced by agrarian cropping systems. Agriculture began in fertile river valleys where sediment and organic matter deposition by annual flooding resulted in deep soils well suited to cropping. From simple agricultural beginnings we have subsequently industrialized and converted much of the world's grassland and good soil into crop production. Soil impairment began with losses of organic matter. Nutrient losses followed. Since weeds thrive in nutrient-poor and disturbed soil, the stage was set for explosive growth.

Cheatgrass (*Bromus tectorum*) has taken root on over 100 million acres of rangeland in the Rocky Mountains (Ditomaso, 2000). Cheatgrass, like other annual invasive grasses, is sometimes allelopathic, grows aggressively in the early season, shallow rooting, drops copious seeds and dries out early in the year providing flash-fuel creating increased risk of fire conditions. The abundance of fuel from cheatgrass has resulted in a shift in the fire interval from every 60-110 years to less than five years today (Ditomaso, 2000). Wildfire generated carbon emissions – one third of the world's carbon emitted – generates "a feedback" that exacerbates climate change. Increases in wildfire from levels to which ecosystems are adapted degrades native grassland vegetation, habitat for biodiversity, water supplies, and other key aspects of the integrity of ecosystems and their ability to provide services for people" (IPCC 6, Technical Summary).

The ecological implications of cheatgrass invasion include but are not limited to low soil condition, low species diversity, and low forage quality. Its presence is an indicator of poor soil conditions. These poor conditions – low mineral and nutrient content for other desirable species, low organic matter and thus low water holding capacity, low nutrient cycling, low below ground species diversity and thus a lack of plant-microbe symbiosis – combined with the allelopathic characteristics of cheatgrass have allowed for a feedback cycle of degradation of range diversity unfavorable to native species that evolved with lower-intensity fires (Fusco, 2019). This cycle has compounding effects on species diversity of perennial vegetation ability to thrive, causes hotter and drier range, and results in low nutrient content forage for grazing wildlife and livestock.

The economic implications of cheatgrass invasion include but are not limited to loss of forage, loss of and damage to habitat, loss related to fire including resources to fight fire, and damage to infrastructure and homes. Rangeland weeds cause an estimated loss of $2 billion annually (Ditomaso, 2000). The US Dept. of the Interior spent $466 million on fire suppression in 2012 (Cheatgrass Management Handbook, 2013). Managing cheatgrass thus far has required financially and socially expensive chemical inputs, followed by the costs of reseeding treated areas. And despite high effort from firefighters and land restoration practitioners alike rangeland conditions have continued to decline.

Change in Management: Solutions?

Historically, the go-to solution has been to apply petrochemicals in attempt to eliminate weeds and undesirable species and reseed for desirables. Some integrative strategies that have been used are some combination of two or more strategies including herbicide, revegetation, tillage, fertilization, grazing, biocontrol, and burning (Ditomaso, 2000). These methods have come at an immense cost to agencies and taxpayers and resulted in little success while simultaneously adding toxic chemicals to our public lands, waterways, and our livestock destined for our dinnerplate.

The introduction of noxious rangeland weeds is associated with human activities and "preventing the introduction of rangeland weeds is the most cost-effective method for management" (Ditomoso, 2000). This is clearly not an option for addressing the cheatgrass issue, especially when "invasive plant species are predicted to expand both in latitude and altitude" (IPCC Technical Summary). The best opportunity for addressing cheatgrass infestation is to monitor disturbed sites, such as burned sites, and to interrupt establishment. Many management strategies available to land managers involve working to avoid invasive plant establishment or to maintain desired species through practices such as proper grazing management, educational programs, early detection, and monitoring (Menke, 1992) (Ditomaso, 2000). Prioritizing landscapes and methods resulting in varying degrees of intervention needed based on the degree of severity of degradation could be the best approach to managing cheatgrass and the related fire cycles (Chambers, 2019).

Truly addressing the problem will require acknowledging the root cause(s) that have allowed cheatgrass to flourish. The presence of cheatgrass is an indication of disturbance to soil and plant communities. Bringing soil health back to equilibrium through reestablishment of perennial native vegetation and especially perennial grasses would likely result in a more productive plant community and thus more diverse and resilient rangeland. We need to shift our management paradigm to one of managing for what we want by putting our energies and resources into creating an environment for healthy plants and soils to flourish, rather than creating a limiting environment by managing for what we don't want.

Parting Message

Formerly healthy rangeland soils and perennial grasslands have lost species richness, have lost soil organic carbon, have lost fertility, have lost infiltration capacity, have lost productivity for grazing, and have become invaded by early successional plant species. In parallel with degradation of these formerly rich grasslands, the arid western United States has become fire prone. More than 100 million acres (156,000 square miles) of western rangeland may be affected. Collectively this area of degraded grassland is larger than the State of Montana (147,000 square miles) and declining further in health every year as rangeland fires increase in frequency and intensity. Without intervention to reverse the decline of grasslands our wildlife and watersheds will only be a memory. Ranching will become ever more unprofitable. Endangered species will become even more imperiled. Economic losses will stretch into untold billions, undermining the stability of rural communities.

> *"Regional increases in temperature, aridity and drought have increased the frequency and intensity of fire. The interaction between fire, land use change…and climate change, is directly impacting human health, ecosystem functioning, forest structure, food security and the livelihoods of resource-dependent communities." (IPCC Technical summary, p. 8)*

To reverse these negative outcomes and restore our remaining grasslands we need to shift our management paradigm. A few changes can result in an immense positive impact in grassland forage quality and species diversity, reversing drought conditions, reducing, and potentially eliminating the use of petrochemicals in our nations wildlands and our food and water.

References

Boufford, D. E. (1993). Poeceae. *Flora of North America Editorial Committee*. *Flora of North America North of Mexico*. Online. New York and Oxford. Vol. 3. Retrieved: 3/6/22 from http://floranorthamerica.org/Poaceae

Chambers, J.C., Brooks, M.L., Germino, M.J., Maestas, J.D., Board, D.I., Jones, M.O. & Allred, B.W. (2019) Operationalizing Resilience and Resistance Concepts to Address Invasive Grass-Fire Cycles. *Front. Ecol. Evol*. 7(185). doi: 10.3389/fevo.2019.00185

Colorodo State University, University of Wyoming. (2013). Cheatgrass Management handbook:Managing an invasive annual grass in the Rocky Mountain region. *U.S. Department of Agriculture– National Institute of Food and Agriculture*. https://www.wyoextension.org/publications/Search_Details.php?pubid=1837

Ditomaso, J.M. (2000). Invasive weeds in rangelands: Species, impacts, and management *Weed Science*. 48(2) 255-265.

IPCC 6. (2021, February 8). Fact Sheet - North America. Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/about/factsheets/

IPCC 6. (2021, February 8). Technical Summary. Impacts, Adaptation and Vulnerability. Technical summary. https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_FinalDraft_TechnicalSummary.pdf

Menke, J.W. (1992) Grazing and fire management for native perennial grass restoration in California grasslands. *Fremonita:A Journal of the California Native Plant Society.* 20(2):22-25