



# LESSON THIRTEEN:

The Role of Fire in  
Rangeland Ecosystems




# Fire As a Force in the Development of Rangelands

Throughout their development, ecosystems in North America experienced periodic fire. Because of this exposure to fire, the resulting ecosystems were fire dependent and contained fire-adapted plant communities.

The fires were both natural fires and fires set by people.

# Fire As a Force in the Development of Rangelands



## Natural Fires:

On average there are 100 lightening strikes/second world-wide

- *3 billion strikes/year*
- *Lightening causes 2,000 – 75,000 fires in the US*

# Fire Was a Force in the Development of Rangeland

## Fires set by Humans

- Grasslands across the world would not exist if people had not used fire. In North America, people used fire as a tool from the end of the ice ages until about 150 years ago. Fire prevented the conversion of rangelands to forest or shrublands.
- According to anthropologist Omar Stewart (*Barriers to Understanding the Influence of Use of Fire by Aborigines on Vegetation*), Native Americans used fire as a tool to clear land for planting crops, improve visibility by removing brush and trees, facilitate travel, drive game, improve vegetation for game, improve approach to game, and to kill insects, rodents and reptiles.



Charles M. Russell painting of Native Americans lighting fires on the Great Plains of North America

# Fire Was a Force in the Development of Rangeland

- According to Dr. Dirac Twidwell, University of Nebraska-Lincoln Rangeland Ecologist, fire was a regular occurrence in grasslands:
  - *One-third of the tall grass prairie burned each year*
  - *Burns ranged in size from large to small*
  - *Extreme fires (high winds, high temperatures, low humidity, low fuel moisture) were common but low intensity fires were also common.*
  - *Human ignitions occurred over all seasons.*
  - *Fire events were highly predictable.*
  - *The landscape was heterogeneous (varied in vegetation height, density and age of vegetation) due to the burned/unburned pattern.*

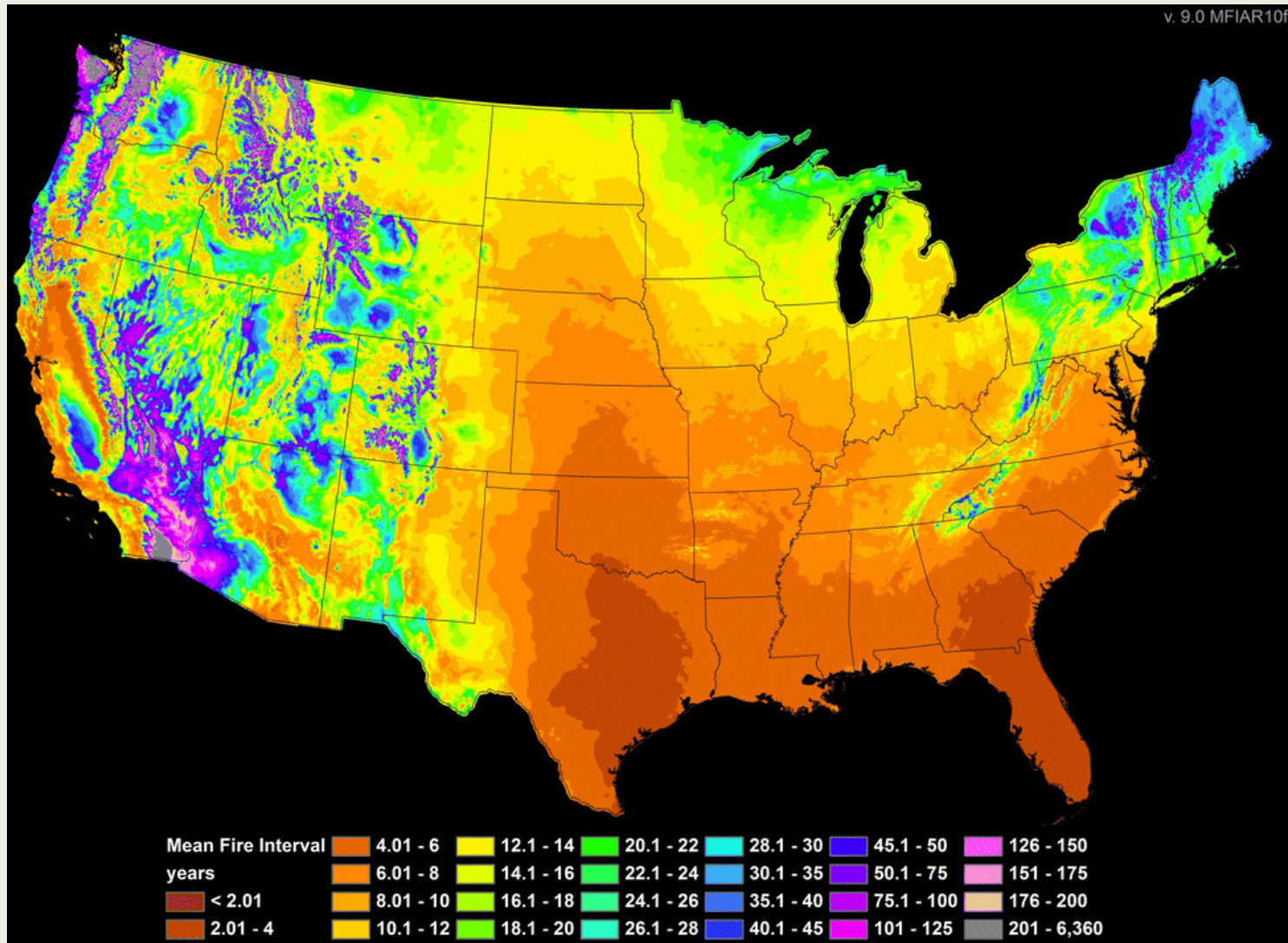


*Photo: Mixed grass Prairie approximately 2 months after a spring prescribed burn.*



# Frequency of Fire in North American Ecosystems

In a 2012 publication, [Predicting Fire Frequency with Chemistry and Climate](#), Richard Guyette and his colleagues predicted fire frequencies for North American Ecosystems. Their fire frequency map for the continental US is shown below.



# Frequency of Fire in North American Ecosystems

Fire in general was more frequent in the non-desert portions of the southern US and was less frequent in the northern US and in desert areas.

A few North American ecosystems – Sonoran Desert and Salt Desert – have no fire histories.

In Nebraska, the estimated frequency of fire was 6 - 14 years, decreasing from east to west due to the decrease in biomass production.

*Photo: Sonoran Desert near Tucson Arizona is an ecosystem that did not develop with fire.*





# Benefits of Periodic Fire

Since most North American ecosystems developed with fire, fire is a needed element in ecosystem dynamics.

- Fire serves a role in maintaining rangeland health, plant composition and diversity.
- Fire releases minerals and nutrients converting them to inorganic forms that are more available for plants to use.
- Fire removes dead and decadent biomass that has accumulated in rangeland plant communities.
- Low intensity fires improve plant productivity.

*Photo: Late winter wildfire near Ogallala, NE*





# Removal of Fire Has Caused an Ecological Imbalance

- Plant communities are more susceptible to becoming dominated by invasive species.
- Plant communities are less diverse.
- The structure of the plant community changed.
- Grass dominated ecosystems have been converted to tree or shrub dominated ecosystems – this is a transition from the reference state to a different state.
  - *Fire suppression has favored juniper and other evergreens at the expense of grasses. Periodic fire kept these woody species in check so that they were a minor component of the plant community.*
- Forest ecosystems change from an open forest with large healthy trees to a dense forest with crowded trees. These trees are more susceptible to insect damage and disease.
- Fire tolerant ecosystems have been replaced with flammable ecosystems.

*Photo: Parts of the Loess Canyons, near North Platte, have been converted to a eastern red cedar forest.*



# Why Was Fire Removed From the Landscape?

Fire suppression in the Great Plains began about 150 years ago as the area was homesteaded. Nineteenth century settlers feared wildfires which burned crops, livestock forage, and homes and sometimes caused loss of life. Farmers and ranchers still did some low intensity, small burns to remove vegetation to facilitate cropping, but to the extent that Native Americans had used fire.

Intense fire suppression efforts in the United States began in 1910 as a result of the “Big Blowup” when a series of forest fires burned 3 million acres in Montana, Idaho, and Washington in only two days.

- US policy came to be prevent fires and suppress any wildfires as quickly as possible.
- In 1944, The US Forest Service introduced Smokey Bear to help spread the fire prevention message.
- The goal for forest service land was to have all wildfires extinguished by 10:00 am.

In non-forest landscapes, barriers to use of fire included ownership boundaries and fences, reduced fuel loads due to cropping and harvesting methods and overgrazing.

As fire suppression efforts in forests continued, fire came to be seen only as a negative force. This generated a lack of understanding of the importance of fire in ecosystem function.



# Impact of Removal of Fire from the Landscape

- Removal of fire has increased the amount of woody biomass to unnatural levels in many ecosystems.
- This increase in woody biomass causes higher fire intensity and larger fires.
- Fires become so intense that they remove shrubs and other plants that would have survived a less intense fire.
- The resulting extreme fires are difficult and dangerous to control. Many are so intense that suppression is difficult if not impossible. Loss of life (firefighters and people living in the area) can occur.
  - *For example the 2018 Camp Fire in California claimed at least 85 lives.*
- Fires are more unpredictable events and are often natural disasters.
- Loss of homes and other structures and economic damage due to wildfires can be devastating to communities.
  - *Nearly 14,000 homes and many other buildings were lost in the Camp Fire.*
  - *Costs associated with the Camp Fire may reach into billions of dollars.*
- Knowledge about the benefits of fire and how to use fire to meet management objectives has declined.

*Photo: Eastern Red Cedar encroachment into grasslands near Ash Hollow State Historic Park.*





# Plant Response to Fire

- Fire stimulates flowering in perennial grasses and forbs.
- Fire-adapted woody plants release seeds from cones and cone-like structures when burned.
- Some plant species have thick seed coats that do not take in water until cracked by the heat of a fire.
- Some plant species in shrublands have seeds that germinate when exposed to smoke.



# How Do Plants Survive Fire?

- Fire tolerant woody plants have a thick bark, open crowns, and deep roots.
- Fire tolerant shrubs are able to root-sprout after fires.
- Grasses are one of the most fire resistant plant growth forms.
  - *Buds are either insulated by layers of leaf sheaths or located below ground on rhizomes.*
  - *Recovery is rapid; grasses can survive very frequent fires.*
- Sod forming grasses survive fires better than bunch grasses as bunchgrasses often have clumps of old, dead material in their centers increasing fire intensity on the individual plants.

*Photo: Late spring prescribed burn to reduce the amount of smooth brome grass in a native meadow in SW Nebraska.*



# How Are Animals Impacted by Fire?



- Large, mobile animals can move away from low intensity fires.
- Reptiles and invertebrates have higher mortality.
- Habitat changes due to burning impact animals more than the fire.
- Vegetation after a fire is lush, nutritious and highly digestible.
- Nutrient rich habitat draws domestic and wild animals.
- Fire can create a patchy landscape of grassland, shrubland and woodlands or a grassland with patches of different structure. This provides a diversity of habitats for wildlife in a relatively small area.

*Photo: Grouse in spring burned Sandhills rangeland approximately 2 months after burn.*



# Summary



- Fire is a natural disturbance.
- Grassland ecosystems developed with periodic fire events.
- Fires are necessary for ecosystem health.
- Before fire suppression was implemented, fires occurred at different times of the year, were of various intensities, and varied in size.
- Fire suppression has resulted in a build-up of fuel and increase of woody vegetation.
- Wildfires are more intense and dangerous because fire has been suppressed for over 150 years.

*Photo: Mixed grass prairie approximately 3 weeks after a prescribed burn.*

# Activities and References

## Activities

- Study the fire return interval map and identify the fire return interval for your area.
- Identify reasons for the different fire return intervals. Why did fire occur more frequently in SE Nebraska than in NW Nebraska; or why more often in Florida than in Maine?

## References

- <https://globalrangelands.org/topics/rangeland-ecology/fire-tool-land-management>



END OF LESSON THIRTEEN