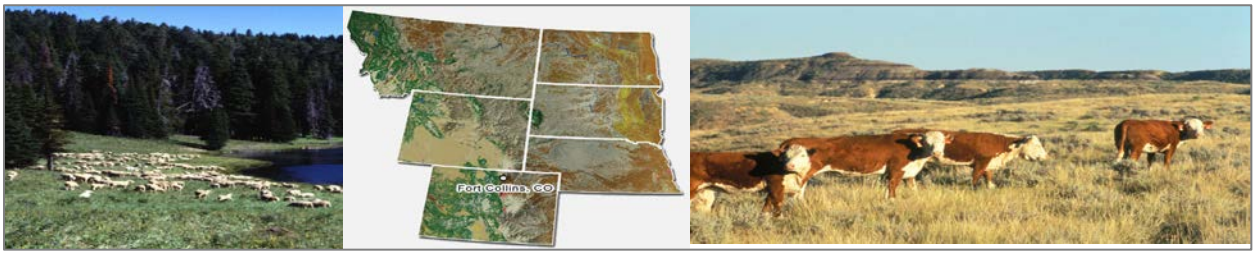
USDA Regional Climate Hubs: Northern Plains

Effects of Drought on Forests and Rangelands in the United States:
A Comprehensive Science Synthesis



Overview:

The Northern Plains contain Montana, North Dakota, Wyoming, South Dakota, Colorado, and Nebraska encompassing landscapes that include more than one-third of the U.S. pasture/rangeland acreage (>140 million acres) and about 60 million acres of forest land. Drought affects plant growth and reproduction and is an important determinant of productivity and species composition. Recent drought trends (2000-2015) are smaller in overall magnitude than those experienced by the Southwest and Southern Plains (Figure 1).

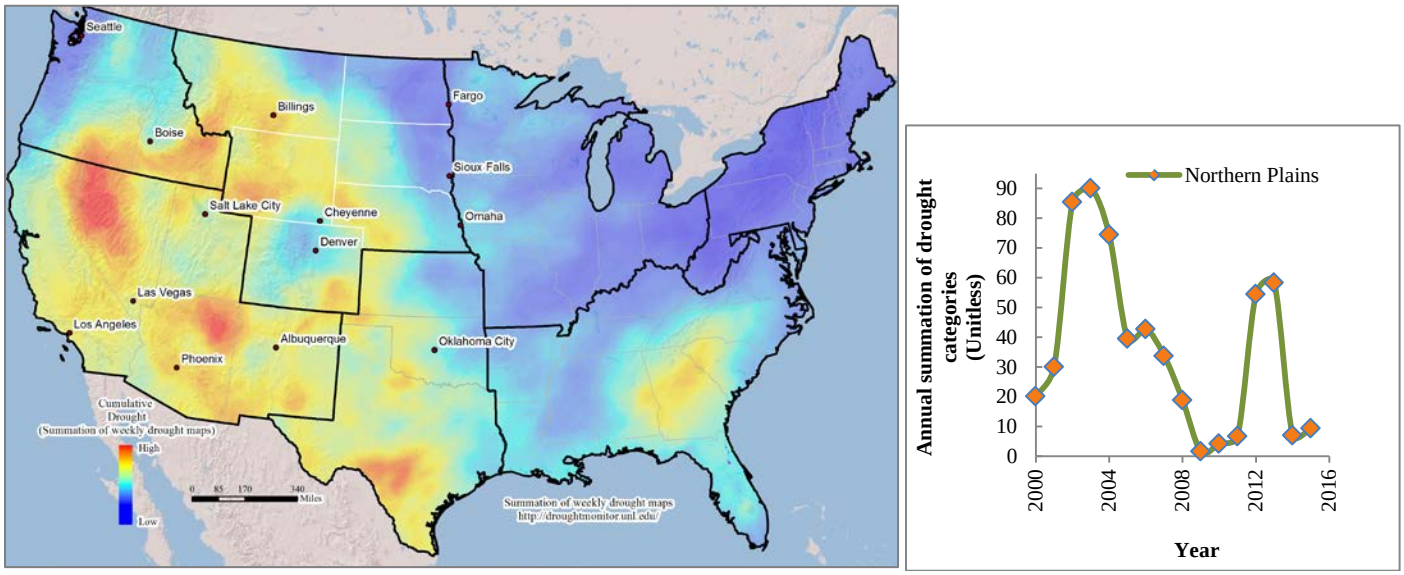


Figure 1. Cumulative summation of unitless drought categories (D0 through D5 from USDA weekly drought maps). Cooler tones represent areas with less cumulative drought, while warmer areas represent areas exhibiting more cumulative drought. Both the map and time series were developed by summing 15-year accumulation of the weekly drought categories from the USDA drought maps (http://droughtmonitor.unl.edu/).

Drought occurrence, severity, and duration in the Northern Plains are highly variable across the region and yield asymmetric impacts on rangelands and forests. The northeastern part of the Northern Plains region has experienced very little drought since 2000 while the western and central portions have experienced significant cumulative drought conditions during this same period. Impacts of these droughts are typified by events such as large wildfires (in 2003, nearly 1 million acres of wildfire were observed following the 2002 drought year) and bark beetle outbreaks in the western portion of the region.

Drought Impacts on Rangeland:

- Decreased vegetation cover and litter exposes more of the soil surface to potential erosion from wind and water.
- Changing phenological patterns and altered species composition occurs as earlier snowmelt, longer growing seasons, warmer temperatures, and altered seasonal precipitation favors some species over others.
- Increased precipitation variability leads to variable forage production, increasing the risks of forage shortages.
- Reduced forage production resulting from drought decreases livestock gains and economic returns.
- Perennial riparian areas become ephemeral as drought increases in duration and severity.
- Reduced spatial configuration of surface water for livestock and wildlife alters grazing distribution.
- Increased competitive ability of invasive species reduces forage production and plant diversity of native plant communities.
- Fire risk increases in drought years following wet years (or seasons), due to the previous year's fuel accumulation.

Drought Impacts on Forest – Rural, Agroforestry, Urban:

- Drier soil conditions increase tree mortality and pest, disease, and insect populations (e.g., bark beetles).
- Increased acreage burned with greater fire severity and increased probability of stand replacing fire.
- Tree species dependent on short summers (high elevation) or summer rain events (island mountain ranges) experience greater tree mortality and transition to shrub or grassland plant communities.
- Prolonged drought reduces success of plantings and recommendations for suitable tree and shrub species will need to be revised.
- Drier soil makes establishment of agroforestry plantings more difficult, requiring irrigation at times.
- Reduced numbers of tree and shrub species in agroforestry plantings increases risk of insect and disease problems.
- During prolonged drought herbicide may be less effective in managing agroforestry plantings.
- Hotter and drier conditions increases flooding potential when high intensity rainfall and wind events do occur.
- Reduced forest species diversity decreases resilience to drought.

Adaptation Considerations of Drought in Rangelands:

Adaptation strategies should emphasize proactive planning and flexibility in enterprise structure and management practices including:

- Incorporating flexible stocking rates, as vegetation recovery following drought is generally proportional to the intensity of grazing before, during, and after the drought.
- Utilizing experiential knowledge of local land managers; for example, asking what strategies others are using and listening to lessons learned from prior drought events.
- Delaying prescribed burning activities until vegetation has had time to recover.
- Managing for a diversity of species and functional groups (grasses, shrubs, and forbs) appropriate to the region.
- Developing contingency plans for emergency feed sources.
- Utilizing grass banking and resting of pastures for forage reserves.
- Including seasonal predictions of temperature and precipitation into adaptive management plans.
- Considering more drought tolerant breeds or species that can travel greater distance to water and are less prone to heat stress
- Determining trigger dates and points for decision-making.

Adaptation Considerations of Drought in Forests:

As soils become drier, available moisture for vegetation growth decreases and adaptation strategies should consider longer time horizons than for rangelands. Management options to deal with this additional stress include:

- Reducing forest stand density to ensure adequate soil water and other resources are available for growth and pest or pathogen which ultimately reduces fire hazard.
- Planting trees with genetic characteristics that confer tolerance to expected environmental stress.
- Managing forests to produce a mixture of tree species, tree ages, and sizes.
- Spacing between planted trees may need to be increased to accommodate water shortages.
- Manipulating forest species densities and snowpack retention to moderate drought impacts.
- Using tools to identify correct species (NatureServe Climate Change Vulnerability Index, USFS Climate Change Tree Atlas).
- Establishing windbreaks and other agroforestry systems to reduce soil erosion by wind.
- Using mulches and other best management practices to conserve soil moisture to help establish agroforestry plantings.
- Consider selecting trees that can reduce heat loads but exhibit relatively lower water demand.
- Planting species with the ability to exhibit drought-induced dormancy.
- Integrating cropping and forestry systems.