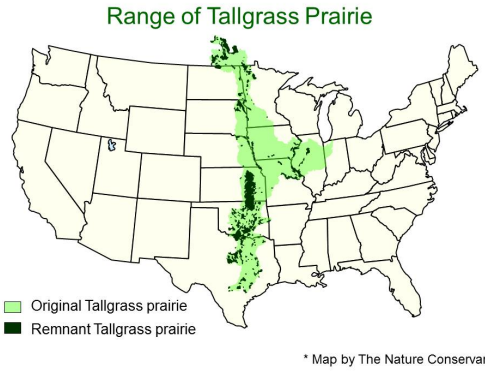
The Tallgrass Prairie

By Jill Haukos



No one is alive today that remembers what the tallgrass prairie once looked like. A sea of grass 167 million acres strong (Samson and Knopf, 1994) once stretched from the eastern edge of Illinois tracking west encompassing Iowa and southern Minnesota and skimming the eastern edges of North and South Dakota, Nebraska, Kansas, and Oklahoma and then snaking down through the eastern side of Texas completely to the Gulf of Mexico. It doesn't look like that now.

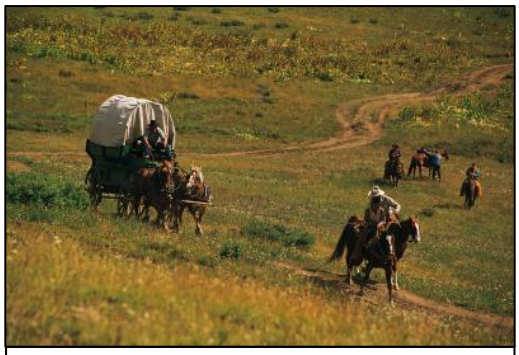
Accounts vary but the amount of tallgrass prairie remaining (since before European settlement from approximately 1830) ranges from about 4% to 13% with the majority still present in the Flint Hills of Kansas (Samson 2004). The Flint Hills with its shallow, rocky soil was impervious to the plow and thus, the prairie remains there today, in places like the Konza Prairie Biological Center.

Konza Prairie Biological Station, 8,616 acres of tallgrass prairie – south of Manhattan, KS

History:

In the early 1800's public perception of the prairie as a "wasteland" or "Great American Desert" was strongly influenced by the reports filtering back from the Corps of Discovery Expedition of Lewis and Clark and other explorers such as Zebulon Pike. At that time a "desert" was defined as a treeless or uninhabited area whether it was arid or not. In the opening of his book The Hunting Grounds of the Great West (pub. 1877), Colonel Richard Irving Dodge states: "When I was a schoolboy my map of the United States showed between the Missouri River and the Rocky Mountains a long and broad white blotch, upon which was printed in small capitals "THE GREAT AMERICAN DESERT – UNEXPLORED" (Webb 1931). According to Major Stephen Long, a government surveyor and expedition leader (ca. 1823) in reference to the Great American Desert (Great Plains region), "I do not hesitate in giving the opinion, that it is almost wholly unfit for cultivation, and of course, uninhabitable by a people depending upon agriculture for their subsistence. Although tracts of fertile land considerably extensive are occasionally to be met with, yet the scarcity of wood and water, great uniformly prevalent, will prove an insuperable obstacle in the way of settling the country" (Meinig,1993).

In the minds of the people in the early 1800's the absence of trees made the prairie unlivable. The irony lay in the fact that the 400,000 people who traveled over the plains on the Oregon Trail (1846 – 1869) did so with the intention of finding good farmland in Oregon and during their travels they crossed and left the most fertile farmland in the world to get to an agriculturally inferior destination. Potential prairie dwellers also had to deal with the reputation of the prairie as a wild place filled with Indians and bison that needed to be tamed. In their minds to occupy this region one would need to invade and conquer it with the proper mindset, tools, and know-how.



Ironically, wagons on the Oregon Trail travelled over the fertile prairie on their way to farmland in Oregon.

Colonization of the American Great Plains began in the early 1800's and between 1830 and 1900 (within the lifespan of one person) much of the tallgrass prairie disappeared. The land remained but the grass was gone, plowed under to reveal the rich, black, fertile soil below. The prairie was a gold mine – it held the nutrients in its depths that would go on to nurture the production of billions of bushels of future wheat, corn, and soybeans. Ironically, the very conditions that supported the growth and development of a tallgrass prairie were the exact conditions needed to support the growth of corn in the central U.S. Looking only at corn, the United States produced 12.4 billion bushels of corn in 2011 at a value of $76.5 billion. The majority of this corn went to the production of ethanol (40%) with food for livestock next (37%) and food products a distant third (11%) (Brester, 2012). The four top states for corn production are, not coincidentally, states that previously held tallgrass prairie: Iowa, Illinois, Nebraska, and Minnesota.

The United States government played a central role in the conversion of prairie into farmland. With the acquisition of land included in the Louisiana Purchase (of 1803), the United States now had 270 million acres of tillable, fertile land (most of it prairie) to allocate to the future farmers of America. The Homestead Act of 1862 promised 160 acres to anyone 21 years old or older who could live on and farm their parcel of land for 5 years (no Confederate solders need apply). The Lincoln Administration was politically motivated to get this new land settled quickly with Union sympathizers (women and former slaves were welcome to apply) to keep Southern states from spreading into the area with their slaves and gaining control of the Union. Another piece of legislation, The Timber Culture Act of 1873, deeded farmers an additional 160 acres if they planted 40 of those acres in trees and kept them alive for 10 years. The absence of trees on the prairie was seen as a hindrance to comfortable living (except it made for

easy farming) and the trees would provide a future source of material for construction, fuel for fires, and a living wind break for the incessant prairie breezes. Thus was the source of trees found on just about every homestead in the prairie.

The new inhabitants needed to support themselves and their families off the land and the prairie offered them flat, fertile land without trees (yet) to hinder the plow. These "sodbusters" used strong teams of oxen or draft horses hitched to a plow to get through the virgin (never before plowed) prairie. They also needed a plow that was different from the eastern wooded version used to till thin, forest soil. Illinois blacksmith John Deere developed the **steel moldboard plow** in 1837 that revolutionized the transition of the land from prairie to farmland. The moldboard design cut deep into the prairie soil and was able to turn over the thick sod that previous plows were unable to cut effectively. The term "sod" refers to the upper layer of soil (approx. 6" – 12") that holds the dense concentration of grass roots. In soil that had never been plowed, cutting through these dense roots was difficult work! The new steel plow made it feasible for farmers to plant their crops in the thick, nutritious soil.

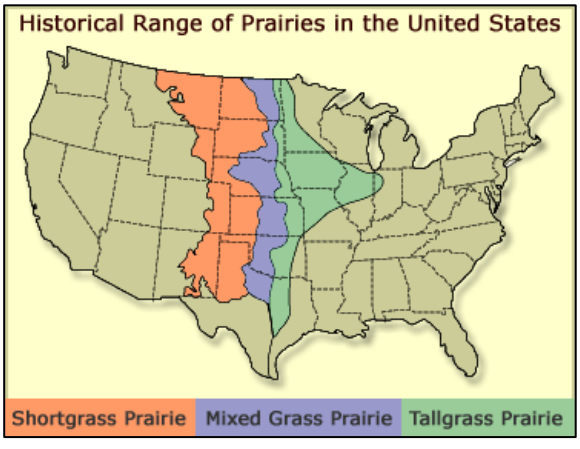
A homesteader breaking the tough prairie soil with a team of horses and a John Deere plow. Photo courtesy of NCSU.

John Deere 1838 moldboard plow.

The tallgrass prairie with its thick soil and available sources of water proved to be an ideal place to farm. As one travels further west the soil gets thinner and the water gets scarcer.

Types of Prairie:

The prairie that once dominated the central part of the United States can be categorized into three different kinds of grasslands: **tallgrass prairie, mixed grass prairie, and shortgrass prairie**. The difference between them is simple – the more rain/snow (precipitation) an area receives each year, the taller the grass. The tallgrass prairie receives an average of 30-35" of precipitation a year and is found on the eastern edge of the Great



Plains. In contrast, the shortgrass prairie, typically found in the western areas of the Great Plains, receives 10-20" of precipitation annually. The mixed grass prairie is, logically, found between the two extremes and typically receives between 20 – 30" of precipitation and contains species of grasses that may be found in each of the other two prairies.

Prairie climate:

Worldwide, grasslands are usually found in the center of a continent, where there is enough rainfall to support grass and forb populations but not enough to support a forest. The climate in these central areas is described as "continental". A continental climate is one where the absence of a nearby large body of water (e.g. ocean) that would normally minimize temperature extremes results in regions experiencing both very cold winters and very hot summers. Rainfall is similarly affected, with some years having high precipitation and other years having very low precipitation. Historically the highest temperature recorded at Manhattan, KS was 121˚F in July of 1936 and the lowest temperature was -40˚F in February of 1905. The average annual temperature is 55˚F. Rainfall events follow a "feast or famine" model where we either have too much or not enough. The highest recorded rainfall for one year was 41.5" in 1951 and the lowest was 15.4" in 1956 (NOAA, 2014).

Snow at Konza Prairie

Because there are few natural barriers, wind is a normal component to the North American prairie. Wind, along with grass, personifies the Great Plains. Whether it is the winter's howling blizzard, a still day on the prairie. Homesteaders commonly mentioned the wind in their journals. This isn't surprising as the prairie is one of the windiest parts of North America (Stooksbury, 2011).

Wind energy is no stranger to prairie-dwellers. For over 150 years, cattle ranchers and farmers have used windmills to draw up underground water for their livestock. Wind can be a valuable natural energy source and is an alternative to fossil fuels (carbon-based fuels derived from the decomposition of plants – petroleum, for example). Wind energy is a rapidly growing industry with large wind turbines and wind farms easily found throughout the Great Plains.

A prairie windmill – using wind power to provide water for livestock on the prairie.

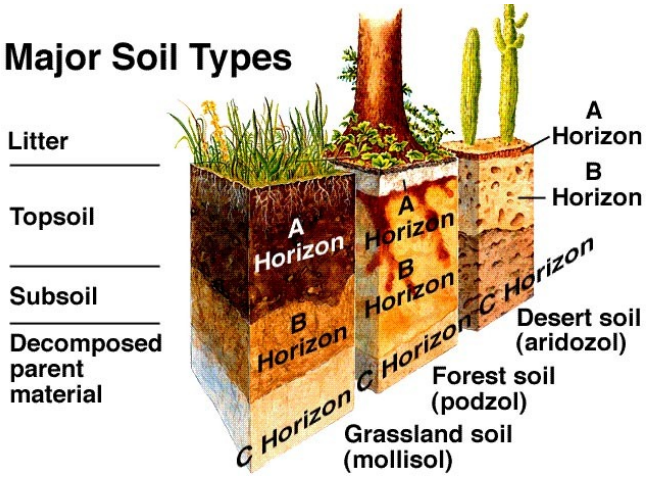
Despite conservation efforts, blowing dust from plowed fields and tumbleweeds piled against fences are still emblematic scenes

on the Great Plains (Stooksbury, 2011).

Prairie soil:

Prairie soils are called **mollisols** and are typically very fertile. These soils are usually limestone-based with a high amount of wind-blown sand and silt (loess) and, in undisturbed sites, a thick area of topsoil that is black with organic matter. Areas around the world that have mollisols are recognized as being particularly fertile agricultural sites such as the Great Plains, the Pampas of Argentina and Brazil, and the steppes of Mongolia and Russia. Years of grasses dying and decomposing and earthworms working nutrients down into the topsoil have rendered this soil very fertile for plant growth (Brady and Weil, 2007).

Normally, the dense, fibrous roots of grasses hold the prairie soil particles in place. If the grasses and their roots are removed, the sand, silt, and clay particles are susceptible to being blown away by the wind. This tendency is exacerbated by dryness due to low rainfall. Therefore, in dry, hot years agricultural fields may lose a large amount of their topsoil to the normal blowing prairie wind.



In the 1930's and again recently, dust storms have plagued areas of the plains – especially the shortgrass prairie (where rainfall is the lowest). Plowing in areas of highly erodible land has led to fine, thin soil being exposed to the strong winds that blow across the prairie, especially in the spring. Farmers could add water to these susceptible fields to hold the soil down but water has become a rapidly diminishing resource in the western plains. The Oglalla Aquifer supplies water for agricultural use but too much irrigation and too little water

A dust storm descends upon Lubbock, TX on October 17, 2011. Lubbock is part of the short-grass prairie.

conservation has led to the rapid decline in the Aquifer's available water.

In the Flint Hills the mollisols are quite shallow with uplands having topsoil of 1' or less and the lowlands having deeper soils up to 4' thick (Reichman, 1987). The thin soils coupled with the very rocky landscape was initially seen as a detriment to agriculture but is now viewed as the salvation of the tallgrass prairie. Because the soils here couldn't be plowed, the tallgrass prairie remains. In other states, most of the tallgrass prairie is all but gone. For example, 99.9% of the tallgrass prairie is gone from the state of Iowa (Samson, et al., 2004) because their thick topsoil could be effectively plowed.

Konza Prairie thin mollisol layer characteristic of the Flint Hills.

Prairie Plants:

Prairies are dominated by **grass** and **forb** plant species. Grasses have long, slender leaves with fibrous roots (not taproots) that are densely concentrated in the first foot of soil. Forbs are broad-leafed plants that do not possess bark and may be referred to as wildflowers or weeds. What is mostly absent from a normal prairie are trees and shrubs; plants that possess bark.

The nature of a prairie is one that is regulated by its dominating climate and by intermittent fires. In the center of the continent precipitation comes in the form of irregular rain storms in the spring and summer and snow and ice in the winter. What it doesn't have is a large body of water that tempers the extremes. Since the prairie is characterized by extremes in both temperature and precipitation, the plants that thrive here are adapted to that climate. When it does rain, the thick fibrous root systems of the grasses rapidly absorb the water, much like a sponge, before the water trickles too far down into the soil column. The nature of trees and shrubs is such that their long taproot systems allow them to access deep, permanent sources of groundwater. This is easy to accomplish in areas with shallow groundwater and regular rainfall. Neither of those conditions are present in a prairie. Because of the irregular rainfall, a tree or shrub rarely lives long enough in a prairie to grow their taproots down to deep permanent water. That is why a normal, healthy prairie will typically only have trees near a creek or pond, not out in the open field.

Grasses and forbs (pink flowered – Catclaw Sensitive Briar) in May in a field that was burned in April - on Konza Prairie.

Plants of the Konza Prairie Biological Center:

Nearly 600 different species of vascular plants have been found on Konza Prairie, and of those 86 are grasses. Here are some of the most common (Haddock, 2005):

The most common species of warm season (= grow and flower in the summer and autumn) **tallgrasses** are:

Big Bluestem	- *Andropogon gerardii*	- grows 2 - 9' tall
Little Bluestem	- *Schizachyrium scoparium*	- grows 2 – 4' tall
Switchgrass	- *Panicum virgatum*	- grows 2 – 7' tall
Indiangrass	- *Sorghastrum nutans*	- grows 3 – 7' tall
Side Oats Grama	- *Bouteloua curtipendula*	- grows 1 – 3' tall

The most common grass species of cool season (= grow and flower in the spring) grasses are:

June Grass	- *Koeleria macrantha*	- grows 8 – 24" tall
Eastern Gamma	– *Tripsacum dactyloides*	– grows 4 – 8' tall
Canada Wild Rye	- *Elymus canadensis*	- grows 3 – 6' tall
Foxtail Barley	- *Hordeum jubatum*	- grows 8 – 30" tall
Smooth Brome	- *Bromus inermis*	- grows 16 – 48" tall

Common forb species (wildflowers) of Konza Prairie Biological Station:

Spring:

Wild Parsley	- *Lomatium foeniculaceum*
Ground Plum	- *Astragalus crassicarpus*
Wild pansy	- *Viola rafinesquii*
Blue phlox	- *Phlox divaricate*
Fringed puccoon	- *Lithospermum incisum*
Violet wood sorrel	- *Oxalis violacea*

Summer:

Cobaea Penstemon	- *Penstemon cobaea*
Butterfly Milkweed	- *Asclepias tuberosa*
Purple Coneflower	- *Echinacea angustifolia*
Black-eyed Susan	- *Rudbeckia hirta*
Leadplant	- *Amorpha canescens*
Western Ironweed	- *Veronia baldwinii*
Hoary Vervain	- *Verbena stricta*

Autumn

Canada Goldenrod	- *Solidago canadensis*
Missouri Goldenrod	- *Solidago missouriensis*
Smooth Aster	- *Symphyotrichum leave*
Dotted Gayfeather	- *Liatris punctata*

Burning the Prairie:


Credit: Jill Haukos

Fire plays an essential role in the ecology and management of a prairie. Fire suppresses the growth of trees and shrubs (woody vegetation) and stimulates the new growth of grasses.

The most important effects of fire on the prairie ecosystem occur through the removal of dead plant material (litter). A thick litter layer reduces light availability to shoots, ties up nutrients, and keeps the soil cool in the spring, delaying plant growth. Removal of the litter layer increases spring soil temperature, which increases both microbe and root activity in the soil. These changes favor the growth of the dominant warm-season grasses.


Credit: Jill Haukos

In years with adequate rainfall, fire increases productivity of tallgrass prairie by 20-40% compared to unburned sites. To date, annual burning has not decreased productivity on Konza. However, when productivity is compared among sites burned in the spring, those sites that had been previously unburned for several years typically have higher productivity than annually burned sites.

Areas of prairie that are burned every 4 – 6 years have higher plant diversity than areas that are burned every year. Annual burning results in a shift toward

dominance by warm-season grasses. Conversely, infrequent fire results in a reduction in prairie grasses and forbs and increases in woody vegetation.

If a prairie (e.g. Konza Prairie) isn't burned then trees (Eastern Red Cedar) and shrubs (Rough-leaf Dogwood and Smooth Sumac) get established and become dominant. Very simply, without burning a prairie may turn into a forest.

A comparison of an infrequently-burned area (left) to a frequently-burned area (right) – on Konza Prairie.

Recent data indicates that there is no one perfect season in which to burn the prairie. Each season has its pros and cons that should be considered when deciding the timing of a prairie burn. Research shows that burning in the fall may be advantageous to managers seeking to promote the growth of forbs (wildflowers) in addition to grasses. If managers simply want a high grass population then burning in the spring may work the best.

Prairie birds that require dense vegetation for successful nesting are more successful in grasses that aren't burned every year. Birds such as the Prairie-chicken prefer grasslands that are burned every 2 – 3 years. Another consideration for land managers is air quality. In previous years ranchers in the Flint Hills of Kansas have been instructed to burn their fields annually in the early spring; typically in April. Since burning requires low wind speeds and humidity between 40 – 70% landowners all seem to burn on the same day in April (with the prescribed weather conditions) and air quality suffers as a result. If ranchers spread out the timing of their burns to include dates in the autumn, air quality may improve (KPBS, 2012).

Animals of the Prairie:

Bison: It should come as no surprise that the animals of the prairie have found their populations in a steady decline since the 1830's. The quintessential species of the prairie is the American Bison. More information on the history of bison may be found here: http://www.konza.ksu.edu/keep/sci_adventures/bison/2_konza_bison.htm

Konza Prairie is home to a herd of 300 bison that have 2,500 acres to freely roam. The bison graze selectively (looking for new, green shoots of grass and other short grasses) and directly affect the composition of the prairie vegetation. By grazing

on certain species of grass they let other grasses grow and generally leave the forbs alone. This selective grazing changes the overall composition of the prairie.

Bison and cattle are not functionally equivalent. Bison maintain large grazing lawns. They return again and again to the same "lawns" to eat the new growth of grass, which is highly nutritious. These areas may look overgrazed but actually have new growth continually, providing the nutritious grass bison need, even if only one inch high. In moderately stocked pastures, cattle tend to graze smaller patches distributed more uniformly throughout the pasture. Plant diversity is greater in bison pastures than in cattle pastures. Forb numbers, especially annuals, are higher in bison pastures. Both bison and cattle primarily consume Big Bluestem, Little Bluestem and Indiangrass on the tallgrass prairie.

Prairie-chickens: These are native birds of the prairie and are more grouse than chicken. These resilient prairie birds thrive in large tracts of native prairie and are very sensitive to habitat loss and degradation. They are well known for their elaborate spring (March through April) mating dance where the colorful males come to a **lek** (an elevated region with sparse vegetation) to call, dance, and otherwise make a display that attracts the attention of hens. The primordial nature of this display – where the chickens seem almost oblivious to anything else around them – is fascinating to witness and is becoming more rare with each passing year. There are two species of Prairie-chicken in Kansas:

Two male Greater Prairie-chickens displaying on a lek – Konza Prairie, April 2012.

1. Greater Prairie-chicken – is found in the tallgrass and mixed-grass prairie and its population is in decline. Have orange esophageal sacs that are obvious in the males during the mating season. Konza Prairie has several GPC leks and offers volunteer-led viewings (sitting in a blind) of the chickens during the spring of each year. Call the Konza Environmental Education Program office for more information – 785-587-0381.

2. Lesser Prairie-chicken – is found in the shortgrass prairie and its population is also in decline. This bird is smaller and tougher than the Greater Prairie-chicken as it lives in a more hostile environment. This species experiences extreme fluctuations in its population due to environmental extremes (weather). The male Lessers have salmon-colored esophageal sacs seen during mating displays.

Prairie Dogs: The Black-tailed Prairie Dog, like the Bison and Gray Wolf, plays a keystone role in prairie ecosystem. A keystone species is one who has a disproportionately large influence on the ecosystem it inhabits. Prairie dogs build underground burrow systems that are complex and contain multiple

openings. These burrows can be huge, occupying miles of prairie and can provide habitat for a large number of other prairie species including Burrowing Owls, Eastern Cottontails, Black-footed Ferrets, and Western Rattlesnakes. The prairie dogs themselves serve as an important food source for predators such as Ferruginous Hawks, Prairie Falcons, Great-horned Owls, Golden Eagles, Swift Fox, Coyotes, and Badgers. Mountain Plovers forage for insects, and Northern Harriers hunt mice in areas where prairie dogs have reduced the grass cover.

Black-tailed Prairie Dogs once numbered in the millions on the Great Plains, mostly in the shortgrass and mixed-grass prairie. Due to their unpopular reputation for adversely affecting pasture quality, their numbers have been reduced by 95% due to an organized program of poisoning and hunting. Conversely, their range has shrunk to about 5% of its historic area (Jones and Cushman, 2004).

Threats to the Prairie:

Of the three types of prairie, the tallgrass prairie is the most imperiled, primarily due to the conversion of prairie to agriculture. In some states (Iowa, Illinois, Indiana, for example up to 99.9% of the historical (pre-European settlement) tallgrass prairie is gone (Samson and Knopf 1994). Additional threats to the remaining tallgrass prairie include:

- Invasive species such as Sericea lespedeza
- Suppression of fire – leading to establishment of Eastern Red Cedar, Rough-leaf Dogwood and Smooth Sumac
- Continued development of existing prairies into housing and farming areas

Sites of Protected Tallgrass Prairie:

Minnesota:

Northern Tallgrass Prairie National Wildlife Refuge – 1,800 acres – 44843 County Rd 19, Odessa, MN 56276

Illinois:

Midewin National Tallgrass Prairie – 18,226 acres – 30239 Rt. 53, Wilmington, IL 60481

Iowa:

Broken Kettle Grasslands Preserve – 3,000 acres – Sioux City, IA

Neal Smith National Wildlife Refuge – 8,652 acres – 9981 Pacific St., Prairie City, IA 50228

Kansas:

Konza Prairie Biological Station – 8,616 acres (Flint Hills) -100 Konza Prairie Lane, Manhattan, KS 66506

Tallgrass Prairie National Preserve (U.S. National Park Service) – 10,894 acres (Flint Hills) - 2480 Highway 177, Strong City, KS 66869

Oklahoma:

Tallgrass Prairie Preserve (The Nature Conservancy) - 45,000 acres (Flint Hills) – north of Pawhuska, OK

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