Prairie Precipitation: It's a Big Deal

Jill Haukos Haukos

The Field Journals are made possible in part with funding from the Fred C. and Mary R. Koch Foundation.

Flint Hills
Ruth Loveland

PRAIRIE PRECIPITATION

IT'S A BIG DEAL

Water is a big deal for the prairie.

Obviously, water is needed for life, but consider this: the prairie often goes for long periods of time without water, and native plants and animals survive, and often thrive. Consider the connections between water and life on the prairie.

Precipitation is never guaranteed for organisms that live on a prairie and certainly not when rain is critical for growth and survival. Prairie residents know the reality of precipitation. After experiencing a couple of years of "normal" weather with a lovely 30-35 inches of precipitation, we may begin to expect these amounts every year. Unfortunately, the prairie sometimes has other plans.

Periodic droughts are part of life on the prairie. For example, nine of the 11 years from 1929 to 1939 were drought years known as the Dust Bowl that led to the Great Depression. Tree ring data shows a hundred-year drought beginning in 1482. Any time precipitation occurs on the prairie, even if it occurs outside of the time when plants are growing — like this year's snow and ice — we are still grateful for it.

Prairies and other grasslands experience challenging weather because these ecosystems naturally occur in the middle of large continents, long distances from large bodies of water like an ocean or Great Lake — defined as "big water." Because grasslands are far from big water, they aren't subject to the natural tempering of weather provided by water. Water absorbs heat, making summers cooler, and releases heat, making winters warmer. Without tempering by big water, grassland summers are hot, and winters are cold. The bulk of our precipitation typically arrives during spring and summer, usually in the form of seasonal thunderstorms.

Here's where evolution becomes part of this story. To live in a prairie, plants must survive hot summers, cold winters and unpredictable precipitation. When the precipitation does arrive, having a root system that can quickly and efficiently absorb water like a sponge before it washes away is advantageous. Grasses have such roots; in fact, it's those specialized fibrous roots of grasses that enable them to be dominant plants of the prairie.

There are two basic strategies for plant root systems: taproots and fibrous roots. Taproots are found in trees; these roots take several years to grow, but, because they can eventually reach deep groundwater, trees can survive for years pulling from that water source. Fibrous roots function the opposite of taproots. Fibrous roots are thin filaments concentrated in the top 12 inches of the soil, like an explosion of small tubes. When the unpredictable rains do arrive, fibrous roots quickly absorb the precipitation, keeping it from sinking down into the soil. These roots are evolutionary dynamos that allow grasses to out-compete other plants.

The additional advantage of grass root systems occurs during droughts. In the absence of rain, when life gets really tough, grasses don't die; rather, they enter a period of dormancy. Outwardly, their leaves turn brown; they quit growing and appear dead. Below ground, their roots and specialized storage stems called rhizomes are still very much alive. Some species of native tallgrasses, particularly little bluestem, can remain dormant, but alive, without so much as a drop of precipitation, sometimes for more than a year. It takes an exceptional drought to actually kill native prairie grass species. Evolution ensures that organisms that exist in a prairie are prepared for what the prairie deals out.

The prairie landscape is slowly changing. Trees and shrubs — native, but not normal components of the open prairie — are marching, stopping and setting down roots, taking space away from the grasses and wildflowers that would normally inhabit those places. The main villains are rough-leafed dogwood, smooth sumac and eastern red cedar. This influx of woody plants is occurring because of water — specifically, trees and shrubs are surviving by getting access to water. In the absence of regular fire, woody plants' taproots have enough time to grow and reach permanent groundwater. Climate change is also playing a role.

Normally there's a tenuous balance between water, carbon dioxide and plants in the prairie. Plants absorb carbon dioxide needed for photosynthesis, growth and life functions through their leaves but lose water during the process. Plants that can withstand this tradeoff, like grasses, survive the prairie. Other plants, like trees, usually become water stressed and die. Climate change, though, is altering the equation. Because there is more carbon dioxide in the atmosphere, trees don't have to work as hard to absorb carbon dioxide and don't lose as much water. Simply put, trees and shrubs are better able to survive hot and dry conditions on the prairie because of climate change.

There's no telling when precipitation will arrive on the prairie. It can rain, sleet, snow or hail any month. Which form of precipitation is the "good stuff?" All of it. The snow, ice and cold rain that the Flint Hills receive in December, January and February are useful for prairie life and agricultural production. If the soil has moisture, that bodes well for eventual seed germination in later spring months. Snow and ice on top of the soil can help capture moisture and improve both crop and prairie plant growth and development.

Tallgrasses don't always get super tall. It depends on the timing of the rain in the summer. Specifically, the height of tallgrasses is determined by how much moisture is available when they are actively growing during June and July. It's predictable. If we get rain in June or July, then we know it will be a "tall grass year." If we get rain in April or September but not in the summer, it will be a lovely year, but the grass won't be exceptionally tall.

Student visitors from the Flint Hills and beyond are welcome at the Konza Prairie Biological Station where they learn about the tallgrass prairie and experience it directly with hands-on activities, hikes and tours. One such activity has them study the effect of water on the height of native tallgrasses. We begin by asking students the following question: "Where on the prairie would you find the tallest grass, the top of the hill or the bottom of the hill?" Students intuitively know the logical answer — the bottom of the hill — and as a group, they work through the logic.

When it rains, water hits the ground and what is not absorbed will slowly work its way downhill. In short, the soil will be deeper and moister at the bottom of the hill. To test this hypothesis, we arm the students with data sheets, measuring tapes and grass identification tools. Using that logic, we can then deduce that the grass growing at the bottom of the hill will be taller than grass growing at the top of the hill, because of that deep, moist soil.

Water is a big deal on the prairie. Access to water ensures survival, but the plants and animals that have evolved for life on the prairie can survive normal periodic or even long-term droughts. But with woody plant encroachment and climate change, water equations on the prairie are changing.

Jill Haukos was raised on the tallgrass prairie of South Dakota. She lived on the shortgrass prairie in Texas for a while and realized that prairie anywhere is pretty cool. She's been in the Flint Hills of Kansas leading the Konza Environmental Education Program for 12 years and really loves tall, green grass.