

Where Has All the Water Gone?

Background:

- The Konza Prairie Biological Station – just south of Manhattan, KS – is where research is done on the tallgrass prairie. There is a creek that begins at Konza Prairie, called **Kings Creek**.
- Kings Creek is important to our prairie. It carries water that comes from rain as it **runs off** the hills and water that seeps into the creek from **underground springs**.
- About 2/3rds of the water in Kings Creek comes from underground springs and 1/3rd comes from runoff. The amount of water from each source depends on the season, the total amount of rainfall, and whether or not there's been rain in successive days. If the prairie soil is dry and parched, there is less run off and more absorption down into the soil and down to the underground springs. If there has been several days of rain, then the soil gets saturated and there is more run off.
- Kings Creek is important to many of the animals who live at Konza Prairie. Lots of animals live in the water of Kings Creek and even more visit the creek to get a drink of water. There are fish and crawfish that live in the water and lots of larvae from aquatic insects. There are even beaver that live in and around Kings Creek. Deer, raccoons, and opossum will all come down to the creek for a drink. Interestingly, the bison are rare visitors to the creek, they prefer to get their drinking water from the buffalo wallows.
- **Scientists at Konza Prairie have noticed that the amount of water in Kings Creek is going down.** The water levels keep going down, even when the amount of rain stays the same or even when the rainfall goes up! Scientists asked the question: "Why is the amount of water in Kings Creek going down?"
- The story of water in Kings Creek is a complicated one involving not only the rainfall that helps to recharge the creek, but also the **plants** that use the rainfall.



Kings Creek at Konza Prairie

Data!



Let's look at some data that scientists have collected to help us understand what is happening with the water in Kings Creek:

Table 1 – Mean Daily Discharge of Water in Kings Creek



The blue dotted line indicates that the amount of water flowing in Kings Creek is steadily going down.

Table 1 is showing us the mean (average) amount of water flowing in Kings Creek. There are ups and downs in the black line that are responses to rainfall and dry times, but in general we see that the blue dotted line is going down, meaning the amount of water flowing in Kings Creek is decreasing. The flow in 2020 is less than 50% of what it was in 1983.

Table 2 – Number of Zero Flow Days Per Year in Kings Creek

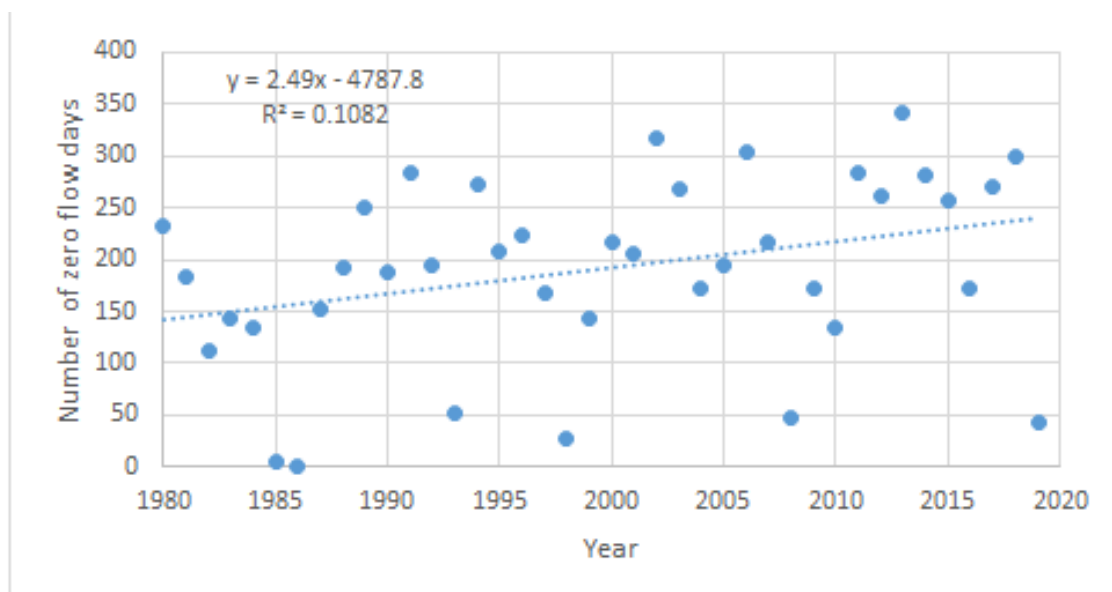


Table 2 is indicating the number of days when Kings Creek had not discernable water flow. There still may have been water present, but it was most likely in puddles or pools, and not in a flowing current.



Now notice the trend line – blue dotted line – how it is trending upwards. This means that the number of zero flow days is increasing each year. That’s bad news for the plants and animals that need water from Kings Creek.



Kings Creek with a zero flow – it has puddles but no flowing current.

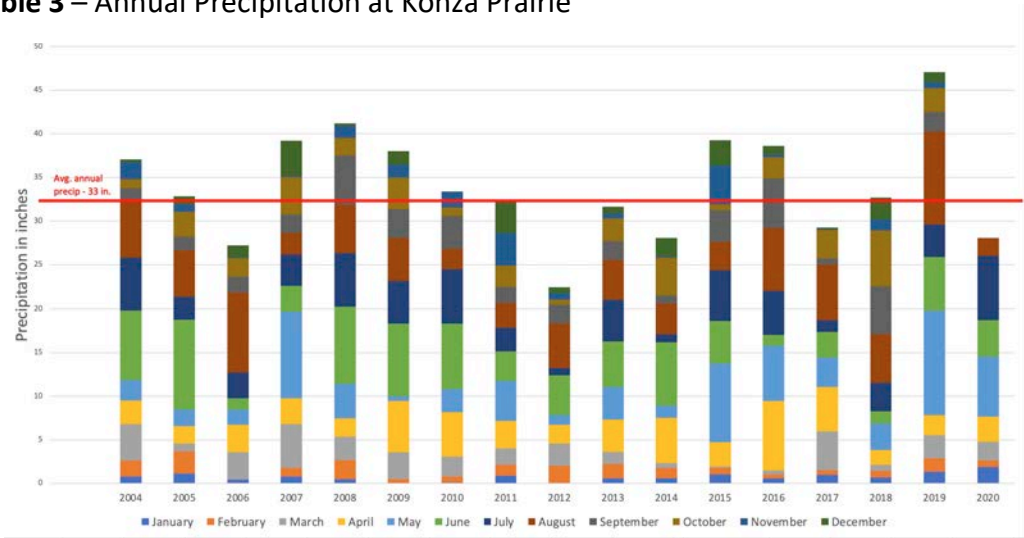


Kings Creek can have high flow days – especially after several days of rain when the rain runs off the prairie

Precipitation!

The average amount of precipitation (includes rain, sleet and snow – all types of precipitation) at Konza Prairie is 33 inches per year. Most of our precipitation occurs during the months of April to October, but there is some variation between the years.

Table 3 – Annual Precipitation at Konza Prairie





Look at 2019 for precipitation in Table 3. Konza Prairie had a very wet year in 2019, with over 40 inches of rain. Now look at Table 1 for the Mean Discharge in Kings Creek in 2019 – it went up because of the rain but the overall trend of flow (blue dotted line) continues to go down.

So, if our rainfall/precipitation is not to blame for the decline of water in Kings Creek, then what is to blame?

Plants!

Plants use water, and different plants use different amounts of water. It appears that a certain **kind of plant** is our culprit in taking the water that once flowed into Kings Creek.

Healthy prairies are composed of two different kinds of plants: grasses and wildflowers (also known as forbs). Grasses have skinny roots that are abundant in the first two feet of soil and then thin out and become straggly at deeper soil levels. Grasses are specialists at absorbing rain quickly and easily – like a thick sponge in the soil – and then shutting down if there's a drought. Wildflowers usually have thicker, deeper roots and often employ underground storage structures, like rhizomes and bulbs, to store water and food for times of drought.

Unhealthy prairies have invading plants – the bad guys in this story – the woody shrubs. There are two kinds of invasive woody shrubs at Konza Prairie: Rough-leaf Dogwood and Smooth Sumac. Both of them are “clonal” meaning that new stems arise from underground rhizomes that are all connected into one common body. The entire plant looks like an island of stems. To kill the plant means you have to kill the entire thing, rhizome and all and it's super difficult, because those roots are deeeeeeeeep underground.



This photo shows a healthy prairie – dominated by grasses and wildflowers

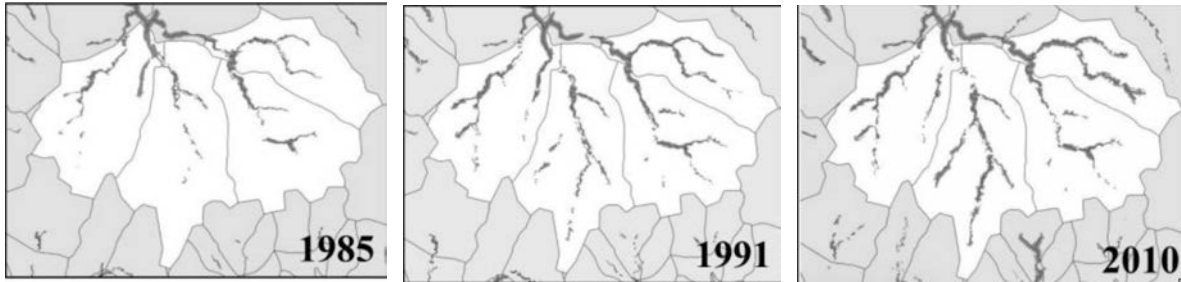


This photo shows an unhealthy prairie that has been over-taken by woody shrubs.

So now the question becomes – **how bad is the shrub invasion at Konza Prairie?**

Shrubs!

- Since the early 1930's scientists and ranchers (scientists arrived in 1971) have noticed that the number of woody shrubs on Konza Prairie has increased. Shrubs, like dogwood and sumac, are a problem because they have long taproots (think of a thick, long carrot-like root) that are capable of reaching underground water.



Each picture shows a section of Konza Prairie with the black dots indicating the presence of shrubs. More black dots = more shrubs.

- **When the shrubs suck up the underground water they keep the creek from getting that water.** The more shrubs there are, the more water they suck up, and the less water there is available for the creek.
- Shrubs are also a problem for the other plants of the prairie. Prairies usually have different kinds of **grasses** and **wildflowers** as the most common (dominant) plants. When shrubs get a chance to grow on a prairie, they grow over the top of the grasses and wildflowers shading them from the sun and killing them. Shrubs are very bad for a prairie!

Fire!

- If shrubs are a problem, then how can they be removed? Or, how can managers prevent them from growing on the prairie in the first place?
- One way that prairie managers keep shrubs from growing on a prairie is by using fire. The flames from a fire will kill a young shrub that is 1-2 years old.
- Any shrub that is older than 2 years old might be able to withstand a fire by having thick, protective bark and a long taproot that can reach underground water. This is why it's important for prairie managers to burn at least every 3 years.



- Shrubs can out-compete grasses and wildflowers by tapping into deep water. They then grow over the top of the normal prairie plants and kill them by shielding them from sunlight and taking all the water and nutrients. This is a problem during a fire because without grasses and wildflowers, there isn't much plant fuel to burn. Fires in shrubs just don't get going, they sputter out.



An area on Konza that is heavily infested with woody vegetation was recently burned. Many of the trees and shrubs survived the fire. Fire does not effectively kill established shrubs.

- Fire functions to make the prairie healthier and more productive.
 - The fire releases nutrients that have been bound up in dead tissues, making them more available for new, growing plants.
 - Fire kills young shrubs, preventing them from getting established in the prairie.
 - Fire opens up the canopy to sunlight, allowing the rays of the sun to heat the soil and spur new growth.



- A prairie that is burned every year is on the left
- A prairie that is burned every 4 years is on the right. The brown sticks are invasive shrubs.



Questions:

1. The amount of water in the creek at Konza Prairie is going down. Why?
2. What are the two basic groups of plants that are normally found in a tallgrass prairie?
3. Shrubs can be very bad for a tallgrass prairie – why?
4. If you were the manager of Konza Prairie how would you control the shrubs?
5. How often does a prairie need to be burned to keep the shrubs out?
6. Where does Kings Creek at Konza Prairie get its water?

7. Take a look at Table 1 – Mean Daily Discharge of Water into Kings Creek. Look at the dotted blue line – it is the overall pattern of the amount of water going into Kings Creek. Is the dotted blue line going up or going down? What do you think that means?

8. How much average annual precipitation is received at Konza Prairie?

9. Does the amount of precipitation received at Konza Prairie affect the amount of water flowing (mean annual discharge) in the creek?

10. What do you think is going to happen to Kings Creek in the future?