Historical Weather Patterns: A Guide for Drought Planning

By Alexander J. Smart, Barry Dunn, and Roger Gates

How do we know when drought will occur? In 2002, the Great Plains suffered through a widespread drought that seemed to catch many ranchers off guard. In South Dakota, there was a flurry of extension activity generated to deal with drought issues. Why were so many ranchers caught off guard? One answer may reside in the patterns of past weather data. Being able to anticipate low rainfall and having the flexibility to handle it has been the common advice by extension personnel and ranchers that have successfully weathered the years. To do this, one has to develop the ability to evaluate historical data in regard to making decisions that have long-term implications for successfully navigating through ranching challenges. Our objective is to present historical precipitation data from western South Dakota and derive certain expectations of drought occurrence to show how this can be used in drought planning.

Annual Precipitation Patterns

It is well understood that the amount of precipitation in semiarid environments is the main factor that determines forage production. The Cottonwood Range and Livestock Station in western South Dakota has been recording weather data since 1909. The power of such information is that patterns emerge that can provide insight into the future, allowing preparation. It is not a crystal ball but at least an informed guide.

Drought is generally defined as 75% of average annual precipitation. At the research station, annual drought occurred 14 times out of 95 years of weather-data collection

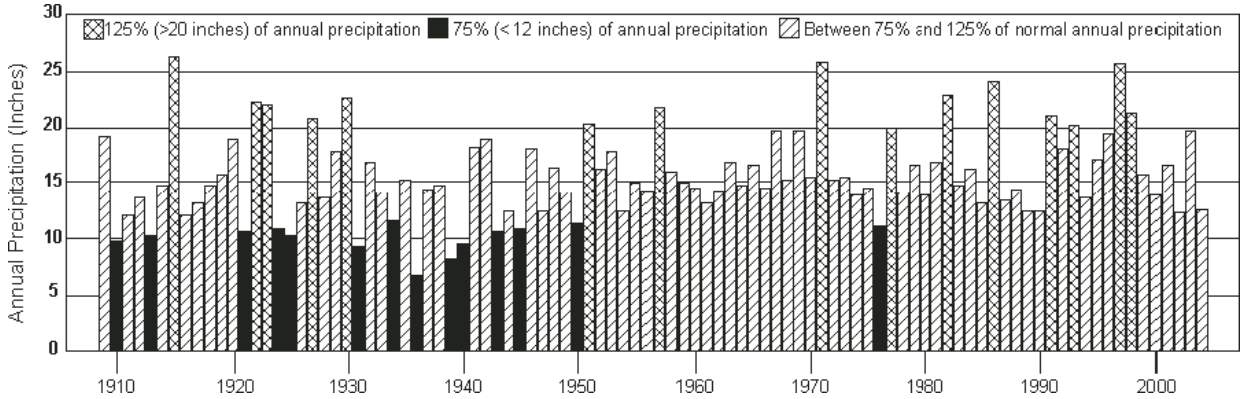

Figure 1. Annual precipitation from 1909 to 2004 for the Cottonwood Range and Livestock Station located 75 miles east of Rapid City, South Dakota, in the mixed-grass prairie. Mean annual precipitation is 16.04 inches (USDC 2004[1]).

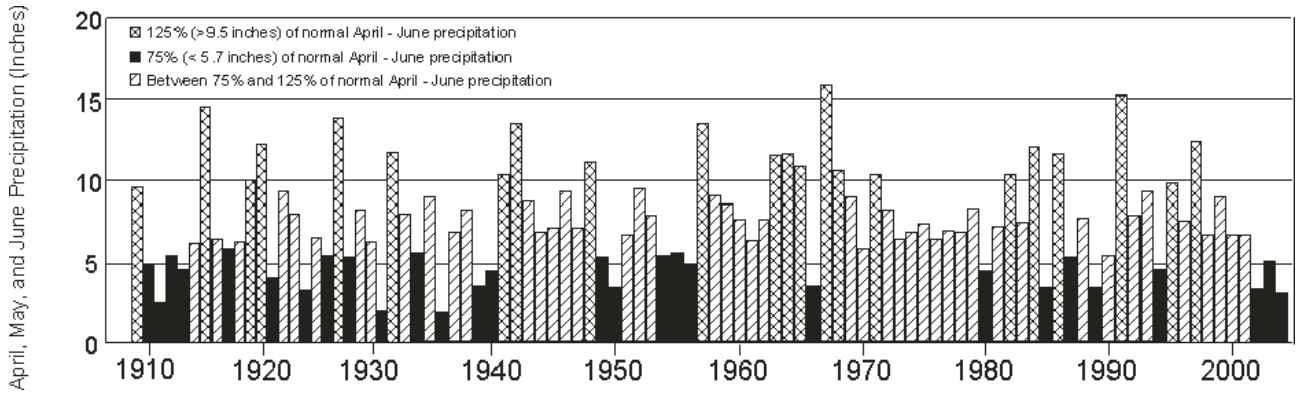

Figure 2. Cumulative precipitation for April, May, and June from 1909 to 2004 for the Cottonwood Range and Livestock Station, located 75 miles east of Rapid City, South Dakota, in the mixed-grass prairie. Mean precipitation for April, May, and June is 7.6 inches (USDC 2004[1]).

(Fig. 1). The last 50 years at the research station have been wetter. However, this might not reflect the true impact on forage-growing conditions because the timing of precipitation in a temperate climate is as important as annual precipitation.

Spring Precipitation Patterns

In the northern mixed-grass prairie of the Great Plains, the amounts of spring precipitation for the months of April, May, and June are particularly important as indicators of the current year's forage production. In a South Dakota agricultural experiment station bulletin published in 1951,[2] the authors recognized this phenomenon and also noticed that summer precipitation was 75% of normal 6 out of 7 years. Because the warm-season grasses consist mainly of shortgrasses, such as blue grama (*Bouteloua gracilis* [H.B.K.] Lag. Ex Griffiths) and buffalograss (*Buchloe dactyloides* [Nutt.] Engelm.), late-summer rainfall did little to increase the season's total forage production because the cool-season forages had already produced the majority of their biomass for that year. In 2004, Heitschmidt[3] confirmed this by examining 15 experiments in the northern Great Plains and found that 91% of the annual forage was produced by July 1.

Cumulative spring precipitation data for the months of April, May, and June from 1909 to 2004 are presented in Figure 2. As one would expect, spring precipitation was highly variable over the 95 years. Above normal (> 125% of the 95-year average), normal, and below normal (< 75% of the 95-year average) occurred 23%, 48%, and 29% of the time, respectively. Looking at the decades of the 1910s through the 1950s, below-normal spring precipitation occurred nearly 40% of the time while only occurring 15% of the time from the 1960s to the 1990s (Fig. 2).

Knowing What to Expect

While it's uncertain what the future will look like, looking at the occurrence of past events gives us an idea about what kind of spring rainfall could be expected given the current rainfall pattern. For example, in 2001, the research station had received 7 consecutive years of above-normal or normal spring rainfall since 1994 (Fig. 2). Given this pattern, the frequency of occurrence of 8 consecutive years of above-normal or normal spring rainfall was very low. In fact, such a pattern only occurred 1 time out of 27 periods, or 4%, between years with below-normal spring rainfall during the last 95 years (Table 1). It shouldn't have been a surprise when drought came in 2002; actually, it might have been anticipated because long periods (> 4) of normal or above-normal spring-rainfall years between spring-drought years are quite low (Table 1).

Back-to-back below-normal spring rainfall occurrence was 33% (Table 1). So when a spring drought does occur, it is not unreasonable to anticipate that another year of below-normal spring rainfall could follow. The good news is that consecutive years of spring droughts don't last as long as the number of years with above-normal or normal spring rainfall (Fig. 2). Most dry periods came in 1-year intervals with below-normal spring rainfall occurring 19 times during the 95 years (Fig. 2). The longest drought lasted 4 consecutive years but only occurred 1 time (Fig. 2).

Conclusion

Understanding historical patterns can lead to effective planning for successfully managing ranch resources. Historic weather records are available and readily accessible for most of the United States. In addition, keeping track of precipitation is probably standard practice on most ranches. In the northern Great Plains, spring rainfall is a better indicator of forage production because this rainfall overlaps the growing conditions for most cool-season forages. Ranchers should expect below-normal spring rainfall to occur about 30% of the time and should plan accordingly. Learning to be sensitive to recent weather patterns and assessing risk will help alleviate the financial struggles and degradation in rangeland resources caused by droughts. In western South Dakota, if

Table 1. Number and frequency of normal or above-normal spring (cumulative April, May, and June) rainfall years between years having below-normal spring rainfall at South Dakota State University's Cottonwood Range and Livestock Station from 1909 to 2004

Normal or above-normal spring rainfall years between years having below-normal spring rainfall	Times occurred	
Event	No.	%
0	9	33
1	5	18
2	3	11
3	4	15
4	2	7
5	0	-
6	0	-
7	1	4
8	1	4
9	1	4
10	0	-
11	0	-
12	0	-
13	1	4
Total	27	100

several favorable spring-rainfall years have occurred in a row, ranchers can probably anticipate a spring drought to occur within the next year or two. If a spring drought does occur, history suggests that the next year's spring could be dry because back-to-back spring droughts occurred 33% of the time. We believe that being able to anticipate low rainfall and stock at conservative rates or have flexible stocking alternatives is still the best advice from extension personnel and ranchers that have successfully weathered the years.

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