Drought and Recovery in the Upper Sonoran Desert

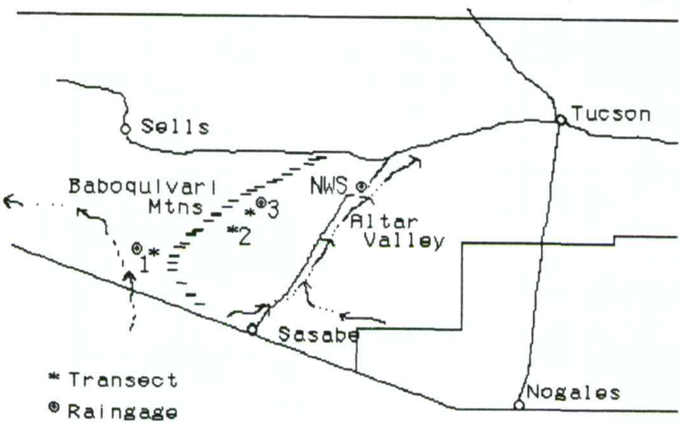
Dan Robinett

The Sonoran desert is no stranger to drought. The frequent occurrence of prolonged dry spells is the one characteristic most responsible for the remarkable adaptions of plants living in this region (Shreve and Wiggins 1964).

A prolonged dry period in the winter-spring of 1988–89 resulted in a serious decrease of perennial grass plants on a Sandyloam upland range site at three locations in the Vamori and Altar Valleys of Pima County, Arizona (USDA-SCS 1990). With the return of normal rainfall in 1990, the surviving plants recovered at two locations and many new plants were established at the other location.

This Sandyloam upland range site lies in the transition area between the Sonoran desert and semidesert grassland of southern Arizona. Photographic evidence from the turn of the century showed it as an open grassland (Humphrey 1987). Today its vegetation cover is more characteristic of the Sonoran desert.

Range sites in this transition area share characteristics of the two adjoining regions. Some sites produce overstories of desert trees and cacti with understories of perennial grasses (Humphrey 1987). Other sites which were open grasslands now resemble the Sonoran desert due to the absence of fire and/or the presence of livestock (Hastings



and Turner 1965, Myrick 1981). These sites are closely aligned to the Sonoran desert classification with the addition of sufficient precipitation to allow perennial grasses to persist.

All three ranches discussed in this paper practice rest-rotation grazing with various numbers of pastures. Monitoring systems had been installed in the early 1980's at key areas on these ranches to assist in the evaluation of the effect of grazing and weather changes on plant cover (USDA-SCS 1976). The monitoring system utilizes pace-frequency transects with 200 plots. Each plot is delineated by a 40-centimeter square frame for evaluating range condition. The transects are installed in key grazing areas.

Transects are read before and after the grazing season to document trends in the plant community and the percentage of plant utilization. Other data recorded includes seasons of use, animal numbers, rainfall, and annual production. Photographs taken at the same time provide a visual record of trends. The data is used to determine what has caused changes in the plant community and how to modify management plans.

Elevations range from 3,200 to 3,400 feet. Mean annual precipitation for the past 47 years recorded at the nearest National Weather Service Station, about 15 miles away at a similar elevation, is almost 12 inches (Hill and Sellars 1974).

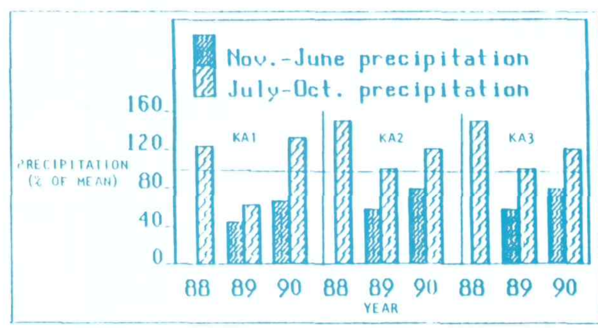


Fig. 1. *Percent of mean precipitation for three Key Areas in Pima County, Arizona.*

The soils at each location are typic thermic haplargids in the Bucklebar series (USDA-SCS 1988; USDA-SCS 1991). These deep soils have gentle slopes with a sandyloam surface 8 to 12 inches thick over a clayloam subsurface.

Rain gauge data showed that only 2 inches of rain fell from November 1, 1988, to July 15, 1989. No measureable precipitation fell in December 1988 or February, April, May, and June 1989. The mean rainfall for this period is 4.5 inches, with May and June being the driest months (Hill and Sellars 1974). This drought followed several years (1982–87) of average or above-average precipitation for the region. This precipitation pattern was representative of most of Pima and Pinal counties in the 1988–89 drought.

Arizona cottontop and Santa Rita threeawn (Gould 1977) are both valuable forage species which dominate sandyloam range sites in this area (USDA-SCS 1990). The changes in percent frequency of both species, at all three locations, show a significant decline from 1987 to 1989 at a 95 percent confidence level. Visual observation

The author is Area Range Conservationist with the Soil Conservation Service in Tucson, Arizona. He wishes to thank Carol Baily, Chris Williams, and Gary Frasier for their help in editing this manuscript and the Miller Family of the Elkhorn Ranch for the use of photos and transect data from their operation.

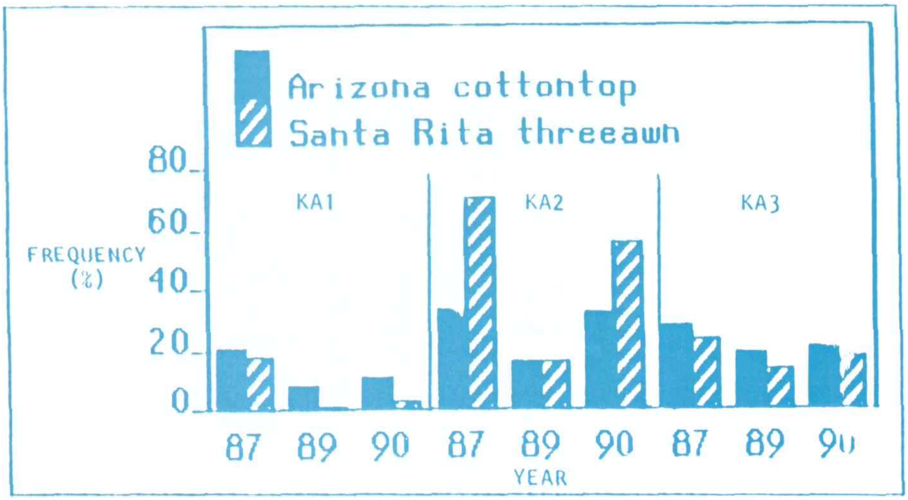


Fig. 2. *Frequency of perennial grasses at three Kay Areas in Pima County, Arizona.*

indicates that better than half of the plants died in this drought.

It appears that differences in grazing use had little impact on plant mortality. Visual observation indicates that grazed and ungrazed plants died in *equal* amounts. This winter-spring drought continued until mid-July 1989 when the first summer rains fell. Grass plants died before the summer rains came.

With the return of normal amounts of rainfall in 1990, the drought was broken. Surviving perennial grass plants regained vigor at all three locations. In Area #2 many new plants of both species established themselves, returning the plant community to nearly predrought conditions. The visible difference between this location and Areas #1 and #3 was the greater amount of litter left on the ground through the drought. This was a result of a combination of two things. First, Area #2 entered the drought with a denser stand than the other two areas. Second, light grazing use at Area #2 before, during, and after the drought left more grass to become litter on the soil surface. By June of 1990, there was virtually no litter left at Areas #1 and #3. The first hard summer rains of July 1990 washed what little organic debris that remained off these upland areas.

The successful establishment of many plants of Santa Rita threeawn and Arizona cottontop at Area #2 appears to be caused by the presence of litter on the soil surface trapping seeds, retarding evaporation, and protecting seedlings until they were established.

A series of photographs taken at Area #2 from 1988 to 1900 shows the deterioration of the plant community caused by the drought and the subsequent recovery in 1990.

A similar drought occurred in 1970–71 across much of southeastern Arizona. During this drought, total live basal cover of blue grama, sprucetop grama, and poverty threeawn was reduced by an average of 69% near Elgin in Santa Cruz County, Arizona (Schickedanz 1974). This death loss occurred in spite of average summer precipitation.

In 1953 to 1956 a drought also occurred with similar results. Winter moisture was 31 to 37 percent below aver-

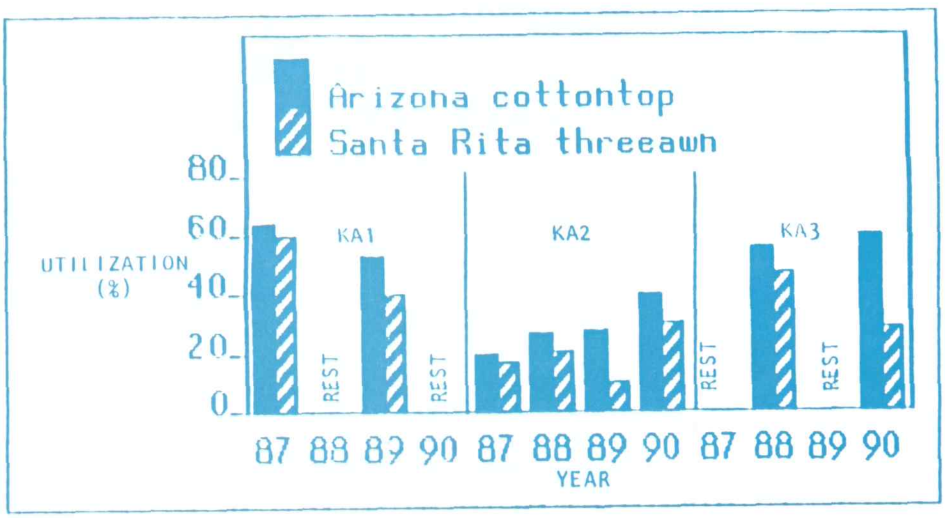
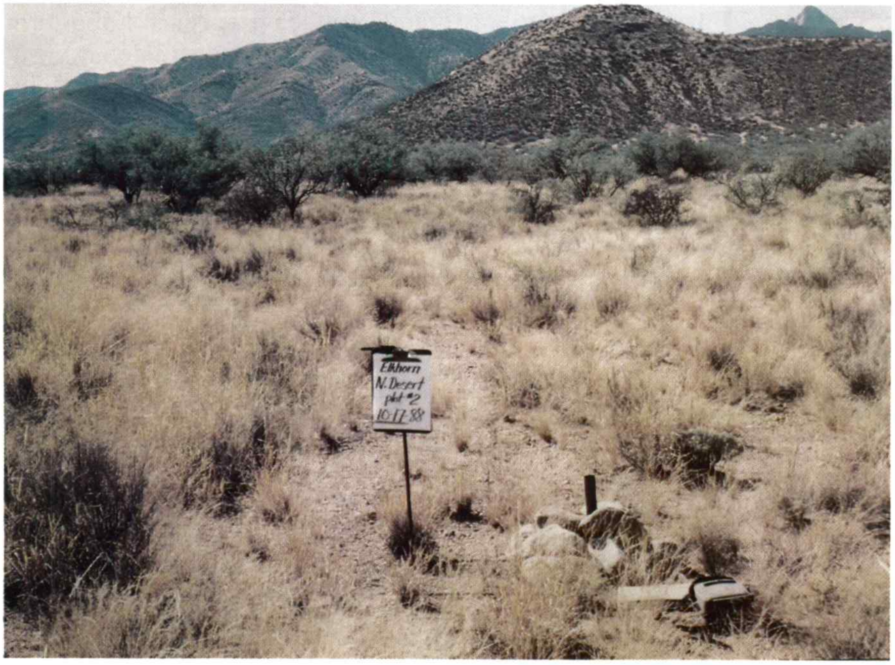


Fig. 3. *Utilization of perennial grasses at three Key Areas in Pima County, Arizona.*



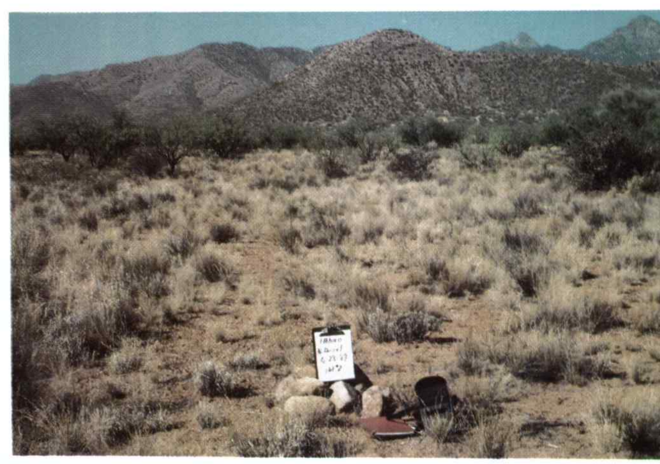
Key Area 2 pre-drought, October 1988. June photos are when utilization was read; October photos are when the frequency transect is read.

age during these years, resulting in a 90% loss in basal area of Arizona cottontop and Santa Rita threeawn at 3,700 feet elevation on the Santa Rita Experimental Range in Pima County, Arizona (Cable 1959). Through this period, summer precipitation was near normal to above normal.

The loss of perennial grass plants in periodic drought cannot be controlled by ranchers and range managers. However the plant communities' rate of response after normal rainfall occurs can be affected by management. Any action allowing litter to remain on the soil surface through a drought will enhance the recovery of the plant community.

Observations made in the drought of 1988–89 and others before (1953–56, 1970–71) indicate that fall, winter, and spring precipitation is extremely important to maintaining plant density in southern Arizona's desert grasslands. Most warm-season perennial grass species in this area are capable of some root and shoot development during the cool season. Adequate moisture for greenup and photosynthesis during this time of year is vital for grass species survival.

Periodic drought is a natural feature of arid rangelands like these in Pima and Pinal counties, Arizona. When it occurs, perennial grasses and other shallow-rooted plants die as the plant communities adjust to the reduced rainfall. This creates openings in the plant community until normal rainfall resumes. Past droughts combined with poor grazing management set the stage for past invasions of non-forage species (shrubs, trees, and cacti) on these ranges. To plan for recurrent drought on rangelands in southern Arizona, ranchers must use a flexible stocking rate. Where the stocking rate remains constant, grazing utilization increases when a drought occurs and forage production declines. This results in little or no herbaceous material to be left as litter on the soil surface.



Key Area 2 entering drought, June 1989.

Key Area 2 mid-drought, October 1989.

Key Area 2 at the end of drought, June 1990.

In planning for drought in this area, a rancher can use cool-season precipitation as one criterion to downstock. When rainfall from November 1 to the end of April is 40% or less of average, it appears that significant grass mortality will occur. Reducing grazing pressure in late spring will help conserve litter and allow for more rapid recovery of the important forage producing species. Long-term grazing management, including drought planning, will allow these species to quickly regain their place in the plant community after drought.

Literature Cited

Brown, David E. 1982. Biotic communities of the American southwest United States and Mexico, Desert Plants. Volume 4 Number 1–4.

Cable, Dwight R. 1959. Some effects of fire and drought on semidesert grasses and shrubs. M.S. Thesis, University of Arizona Tucson.

Gould, Frank W. 1977. Grasses in the southwestern United States. University of Arizona Press, Tucson.

Hastings, James R., and Raymond M. Turner. 1965. The changing mile. University of Arizona Press Tucson.

Hill, Richard H., William D. Sellars. 1974. Arizona Climate. University of Arizona Press, Tucson.

Humphrey, Robert R. 1987. 90 years and 535 miles—vegetative changes along the Mexican border. University of New Mexico Press, Albuquerque.

Myrick, David F. 1981. Railroads of Arizona—volume I—the southern roads. Howell-North Books San Diego, California.

Schickedanz, Jerry G. 1974. Seasonal growth, development, and carbohydrate reserves of three native ranges in response to seasonal moisture and nitrogen fertilization. PhD Dissertation, University of Arizona, Tucson.

Shreve, Forrest, and Ira L. Wiggins. 1964. Vegetation and flora of the Sonoran desert-Volume I. Stanford University Press, Stanford, California.

USDA-Soil Conservation Service 1988. The soil survey of eastern Pima county, Ariz. unpublished. Tucson, Arizona.

USDA-Soil Conservation Service. 1991. The soil survey of the Tohono O'odham Indian Nation, parts of Maricopa, Pima, and Pinal counties, Arizona. unpublished. Tucson, Arizona.

USDA-Soil Conservation Service 1976. National Range Handbook.

USDA-Soil Conservation Service 1990. Technical Range Site Descriptions MLRA 40, 41, Arizona.

Key Area 2 recovery, October 1990.