Determining Drought on California's Mediterranean-Type Rangelands: The Noninsured Crop Disaster Assistance Program

By M. R. George, R. E. Larsen, N. M. McDougald, C. E. Vaughn, D. K. Flavell, D. M. Dudley, W. E. Frost, K. D. Striby, and L. C. Forero

Recent droughts in both developing and developed countries and the resulting economic and environmental impacts and personal hardships have underscored the vulnerability of all societies to this "natural" hazard. Although there are several definitions for drought, they almost always refer to a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. The National Drought Mitigation Center defines four kinds of drought: meteorological, agricultural, hydrologic, and socioeconomic.[1]

In this paper we focus on the precipitation and forage-loss aspects of drought on California's annual rangelands. The goal of this paper is to propose changes to the Noninsured Crop Disaster Assistance Program (NAP), administered by USDA Farm Services Agency (FSA), that would make it more compatible with USDA conservation programs. We begin by discussing the characteristics of drought in California, and then consider the NAP and its application to California conditions.

Precipitation

At least eight multiyear periods of low precipitation have occurred in California since 1900. Droughts that exceed 3 years are uncommon, though occurrences in the past century include 1929–1934, 1947–1950, and 1987–1992. Severe droughts in 1850–1851 and 1862–1864, together with other factors, have been implicated in the conversion of the former native perennial grassland to a grassland dominated by annual grasses and forbs.[2]

Meteorological drought is usually defined on the basis of the degree of dryness compared to some "normal" or average amount and the duration of the dry period. Definitions of meteorological drought must be considered as region-specific because the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region. It is common to define meteorological drought using departures from normal precipitation on a monthly, seasonal, or annual basis.

In California annual precipitation amounts vary greatly within and between years. Additionally, start and end dates of the rainy season are variable. Therefore it is difficult to describe an "average year," although arithmetic averages are reported. If precipitation data were normally distributed there should be as many rainfall years above the average as below the average, but at many locations in California's annual rangelands more than half of the years have below-average precipitation (Figs. 1–3). If we assume that normal rainfall is within 10% of the calculated average rainfall, we find that the 14 stations in Figure 1 are below normal 32% to 56% of the years and above normal 9% to 46% of the years. If we extend the definition of the normal range to within 25% of the calculated average annual rainfall, we see that 16% to 35% of the years for these 14 stations are below normal and 5% to 29% are above normal (Fig. 2).

Forage Loss

Range forage production is strongly influenced by the amount and timing of precipitation. For the range livestock

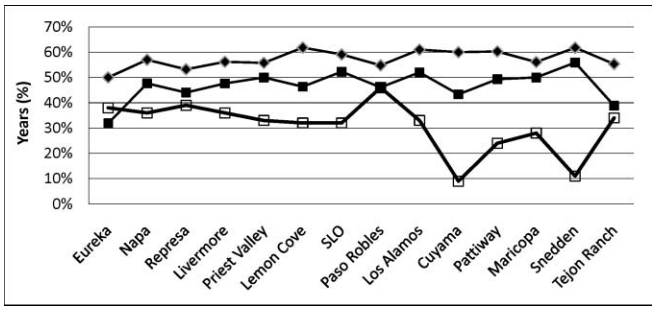

Figure 1. Proportion of years where annual rainfall is below average (♦), below the range of 10% (■) of the mean, or greater than the range of 10% of the mean (□).

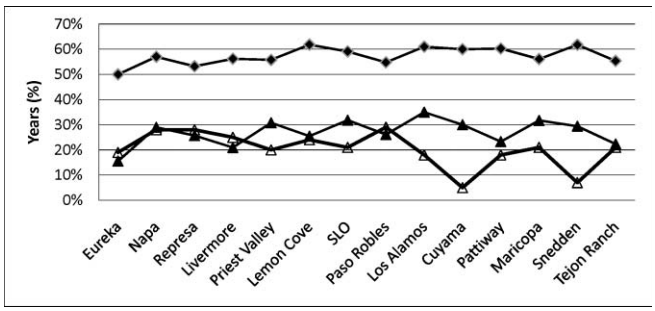

Figure 2. Proportion of years where annual rainfall is below average (♦), below the range of 25% (▲) of the mean, or greater than the range of 25% of the mean (Δ).

Figure 3. Locations of 14 weather stations in Figure 1.

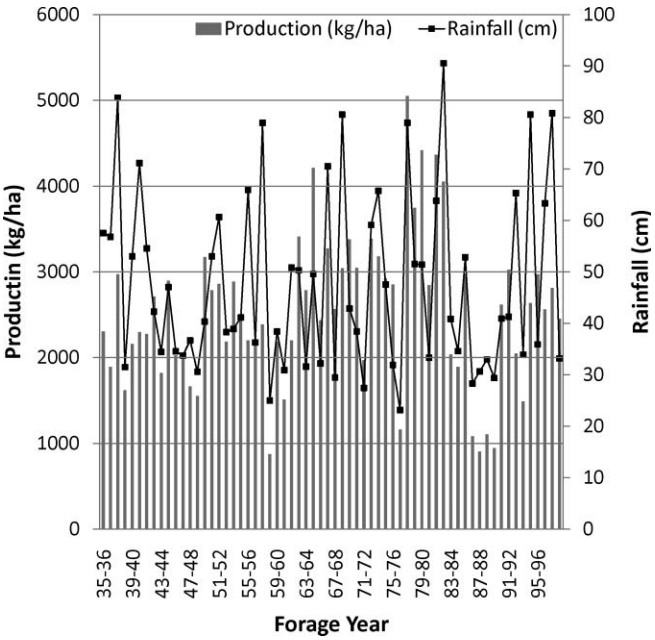

Figure 4. Annual rainfall and yearly forage production at the San Joaquin Experimental Range in Madera County, California.

producer, a normal year is characterized by near-average forage production. High forage yields result from years with early-season (November) combined with late-season (April) rains.[3,4] Because 50% to 75% of annual rangeland forage production occurs in March and April, spring precipitation has a large influence on total annual forage production.

Figure 5. Locations of 26 production monitoring sites in Table 2.

Table 1. Elevation, production, sample size (*n*), and frequency of forage losses (NAP years) exceeding 50% of average forage production at 26 locations in California's annual rangelands

Location (no.)	Location name	County	Elevation (m)	Mean annual production (pounds/acre)	*n*	NAP years (%)
1	Hawes Ranch	Shasta	146	1,485	36	8
2	SFREC	Yuba	302	2,984	26	8
3	HREC	Mendocino	256	2,389	57	2
4	Latrobe	El Dorado	286	1,965	13	23
5	Sutter Creek	Amador	389	3,587	13	0
6	El Dorado	El Dorado	269	3,458	12	8
7	Ione	Amador	159	3,920	13	8
8	Paloma	Amador	330	3,409	13	23
9	Mountain Ranch	Calaveras	664	4,390	11	18
10	Copperopolis	Calaveras	361	3,242	12	8
11	SJER	Madera	320	2,261	72	11
12	Arburua	W. Fresno	327	830	4	5
13	Wisflat	W. Fresno	333	412	4	25
14	Belgarra	W. Fresno	428	1,852	7	0
15	Exclose	W. Fresno	614	981	7	42
16	Grazer	W. Fresno	938	1,263	7	29
17	Delgado	W. Fresno	309	663	7	14
18	Shandon	San Luis Obispo	575	3,813	7	14
19	Adelaida	San Luis Obispo	327	4,180	9	11
20	Cambria	San Luis Obispo	128	7,401	9	0
21	Bitterwater	San Luis Obispo	611	2,198	6	33
22	Camatta	San Luis Obispo	500	1,477	9	22
23	Morro Bay	San Luis Obispo	24	3,868	9	11
24	Soda Lake	San Luis Obispo	807	1,486	6	50
25	Huasna	San Luis Obispo	150	5,558	9	0
26	Carrizo	San Luis Obispo	784	2,983	9	11

NAP indicates Noninsured Crop Disaster Assistance Program.

At the San Joaquin Experimental Range in Madera County, California, the average annual precipitation since 1935 is 48 cm (19 inches with a range of 9–32 inches) and average forage production is about 2,532 kg/ha (2,260 pounds/acre), but has ranged from less than 896 kg/ha (800 pounds/acre) to more than 5,040 kg/ha (4,500 pounds/acre; Fig. 4). Although average precipitation often results in average productivity, near-average production can also occur in low rainfall years (e.g., 1967–1968) or in high rainfall years (e.g., 1955–1956, 1940–1941, 1957–1958, 1994–1995; Fig. 4). Likewise, below-average precipitation often results in low annual forage production, but may result in above-average productivity (e.g., 1969–1970). This demonstrates that timing of precipitation can have a strong influence on yearly production.

NAP Drought Criteria

In some years poor precipitation results in forage production that is 50% or more below average. The USDA FSA NAP provides payments for crop or grazing feed losses that are not covered by a federal crop insurance program. Ranchers who enroll in NAP receive financial assistance

Table 2. Yearly, mean, and 50% of mean range forage production (pounds/acre) for 2001–2009 for nine coastal and inland sites in San Luis Obispo County, California

	Coastal sites				Inland sites				
Year	Adelaida	Cambria	Huasna	Morro Bay	Bitterwater	Camatta	Carrizo	Shandon	Soda Lake
2001	2,343	6,122	4,135	3,627	n/a	1,854	3,457	n/a	n/a
2002	4,359	7,334	4,219	2,316	n/a	1,027	**833**	n/a	n/a
2003	5,071	9,454	4,752	5,730	n/a	1,983	2,590	2,693	n/a
2004	3,106	8,135	6,455	2,949	1,728	876	1,974	2,328	**730**
2005	7,928	8,409	9,026	7,581	3,840	1,773	4,976	5,578	2,506
2006	4,980	10,261	8,434	4,658	3,555	2,764	7,182	8,571	3,956
2007	**1,839**	4,312	4,182	**1,871**	**176**	**482**	1,876	2,309	**29**
2008	4,640	7,324	5,112	3,587	2,907	1,990	2,021	3,844	1,281
2009	3,354	5,257	3,704	2,494	**982**	**546**	1,940	**1,370**	**416**
Mean	4,180	7,401	5,558	3,868	2,198	1,477	2,983	3,813	1,486
50% loss	2,090	3,700	2,779	1,934	1,099	739	1,492	1,907	743

Bold numerals are annual production values that are lower than 50% of mean forage production.

when rangeland forage reductions exceed 50% due to drought. Because precipitation in California increases from south to north and with elevation, the frequency of years with forage production less than 50% of average varies greatly across the state's Mediterranean-type rangelands.

Analysis of annual forage production data from 26 locations (Fig. 5) in California's annual rangelands reveal that a 50% reduction in range forage production rarely occurs north of Sacramento (Table 1). Forage losses of 50% are more common in the rain shadow of the Coast Range adjacent to the west edge of the San Joaquin Valley. Although fewer than 10 years of forage production data have been collected at several of these locations, sample size calculations indicate that 8 years of data are usually adequate for a statistically valid estimate of average forage production for these sites.

California's annual rangeland forage production varies greatly over short distances due to variations in precipitation, soil characteristics, and topography. The coastal areas of a county may have adequate precipitation, but drier inland locations may have low precipitation and forage reductions exceeding 50%. This variation makes it difficult to meet NAP drought criteria throughout the county when only part of the county meets the criteria. Following NAP criteria, drought has been declared in San Luis Obispo County on California's central coast in 2002, 2004, 2007, and 2009. Forage losses for NAP are based on acreage reports and the actual production history (APH) of the ranch.[5] According to the NAP guidelines the APH is the av erage production for a minimum of 4 years and a maximum of 10 years. However, because of large variations in annual production, 4 years of data is not an adequate sample size to determine average forage production. Sample size calculations using the raw data reported in Table 1 indicate that eight or more years of data are needed to obtain a statistically valid average.

Range forage production data collected in San Luis Obispo County is only now approaching the 8 years of data required for an adequate sample size. Six years to 9 years of forage production measurements at nine locations in San Luis Obispo County reveal averages from 671 kg to 3,360 kg (1,477 to 7,400 pounds; Table 2). These data reveal that, since 2001, all inland sites experienced one or more years with production losses exceeding 50% of average with four of the sites having 50% losses in 2007 and/or 2009. The more productive coastal sites have met the NAP drought criteria infrequently since 2001.

Improving the Program

Often the NAP drought declaration is based on subjective criteria such as windshield surveys and phone surveys of county conditions. In California we believe that the following changes to the NAP program would make the drought decision less subjective, more accurate, and more compatible with recommended conservation practices. These changes include 1) allowing declaration of drought in subcounty areas, 2) requiring reporting of carrying capacity and annual stocking rate as part of the APH, 3) requiring forage production measurements (not windshield or phone surveys) by independent forage experts, and 4) revising NAP drought criteria to encourage ranchers to maintain adequate residual dry matter.[6]

Subcounty drought declarations under NAP would allow the program to be focused where there is need. Requiring ranchers in the NAP program to report annual stocking rates and requiring local measurements of forage production levels by forage experts would make the drought decision

less subjective. Guidelines for the NAP program require an independent assessment of forage level by forage experts and record-keeping by the ranchers who enroll in the program.

Drought programs need to be compatible with recommended conservation practices. Following residual dry matter (RDM) guidelines protects soil and future production and species composition.[6,7] Forage reduction criteria should be set at levels that encourage maintenance of these minimum RDM levels. For example, if average production is 2,400 pounds/acre and the RDM standard is 800 pounds/acre, that leaves 1,600 pounds/acre of available forage (available for grazing, trampling, wildlife, decomposition, and other uses/losses). A 50% reduction in average annual production would be 1,200 pounds/acre, leaving only 400 pounds/acre of available forage for grazing, trampling, wildlife, and decomposition after the RDM target of 800 is subtracted. Without linking drought criteria to conservation, the 800 pounds of RDM is consumed, increasing erosion potential and adversely affecting production and species composition the following year. The FSA should consider amending the NAP program in California so that it requires maintenance of minimum RDM levels and starts payments when forage losses exceed 50% of the available forage (total produced minus RDM target). In the example above, payments would start when the average annual production dropped below 1,600 pounds/acre (800 pounds of RDM and less than 800 pounds of available forage). Under this scenario the rancher is more likely to start destocking sooner or feeding hay so that the RDM requirement is maintained. This would potentially increase the cost of the program to FSA (taxpayers) and possibly rancher costs if FSA adjusted the NAP service fee, but it could decrease overstocking on large portions of California's annual rangelands.

The monetary stakes are high for FSA and for the producers. It is crucial to the credibility of the NAP program that it be based on locally accurate information collected using standard methods.

References

1. National Drought Mitigation Center. 2006. What is Drought? Available at: http://drought.unl.edu/. Accessed 15 October 2009.
2. D'Antonio, C. M., C. Malmstrom, S. A. Reynolds, and J. Gerlach. 2007. Ecology of invasive non-native species in California grassland. *In:* M. R. Stromberg, J. D. Corbin, and C. M. D'Antonio [eds.]. California grasslands. Berkeley, CA, USA: University of California Press. p. 67–83.
3. Murphy, A. H. 1970. Predicted forage yield based on fall precipitation in California annual grasslands. *Journal of Range Management* 43:508–513.
4. Duncan, D. A., and R. G. Woodmansee. 1975. Forecasting forage yield from precipitation in California's annual rangeland. *Journal of Range Management* 28:327–329.
5. Farm Services Agency. 2009. Noninsured Crop Disaster Assistance Program for 2009 and subsequent years. Washington, DC, USA: USDA Farm Services Agency fact sheet. 4 p.
6. Bartolome, J. W., W. E. Frost, N. K. McDougald, and M. Connor. 2006. California guidelines for residual dry matter (RDM) management on coastal and foothill annual rangelands. Oakland, CA, USA: Division of Agriculture and Natural Resources, University of California, Publication 8092. 8 p.
7. Hooper, J. F., and H. F. Heady. 1970. An economic analysis of optimum grazing in California annual-type grassland. *Journal of Range Management* 23:307–311.

Authors are Extension Rangeland Management Specialist, Dept of Plant Sciences, University of California (UC), Davis, CA 95616, USA, mrgeorge@ucdavis.edu (George); Area Natural Resources Watershed Advisor, UC Cooperative Extension, Templeton, CA 93465, USA (Larsen); Natural Resources Farm Advisor, UC Cooperative Extension, Madera, CA 93637, USA (McDougald); Staff Research Associate (retired), UC Hopland Research and Extension Center, Hopland, CA 95449, USA (Vaughn); Superintendent, UC Sierra Foothill Research and Extension Center, Browns Valley, CA 95918, USA (Flavell); Range Conservationist, USDA Natural Resources Conservation Service (NRCS), Madera, CA 93637, USA (Dudley); Associate Director, Agriculture and Natural Resources Research and Extension Centers, Davis, CA 95616, USA (Frost); Range Management Specialist, USDA NRCS, Templeton, CA 93465, USA (Striby); and Livestock and Natural Resources Advisor, UC Cooperative Extension, Shasta County, Redding, CA 96002, USA (Forero).