

INTRODUCTION

Large and intense droughts raise concerns, but equally intense droughts may occur at smaller spatial scales, even when large droughts don't.

Typical rangeland management units are 5-15 km², therefore detecting small-scale droughts is critical.

In this study we describe,

- The frequency and duration of different size drought patches,
- How those patterns differ between annual and seasonal time-frames, and
- How those patterns differ after 1996.

METHODS

- Data for the 225 km² Santa Rita Experimental Range (SRER) in southern Arizona with 73 y of monthly precipitation from 22 gauges, temperature from PRISM.
- SRER divided into 100 cells (1.5km*1.5km dimension), precipitation interpolated from 22 gauges.
- Winter (Oct-May), Summer (Jun-Sep), Water Year (Oct-Sep).
- Standardized Precipitation-Evapotranspiration Index (SPEI) includes precipitation and temperature metrics.
- Drought defined as the driest 20th percentile (driest 15 y) for each cell.
- Contiguous drought cells define a drought patch (see Fig. 1).

Figure 2. Distribution of water year, winter and summer drought patches across Santa Rita Experimental Range from 1940-2012.

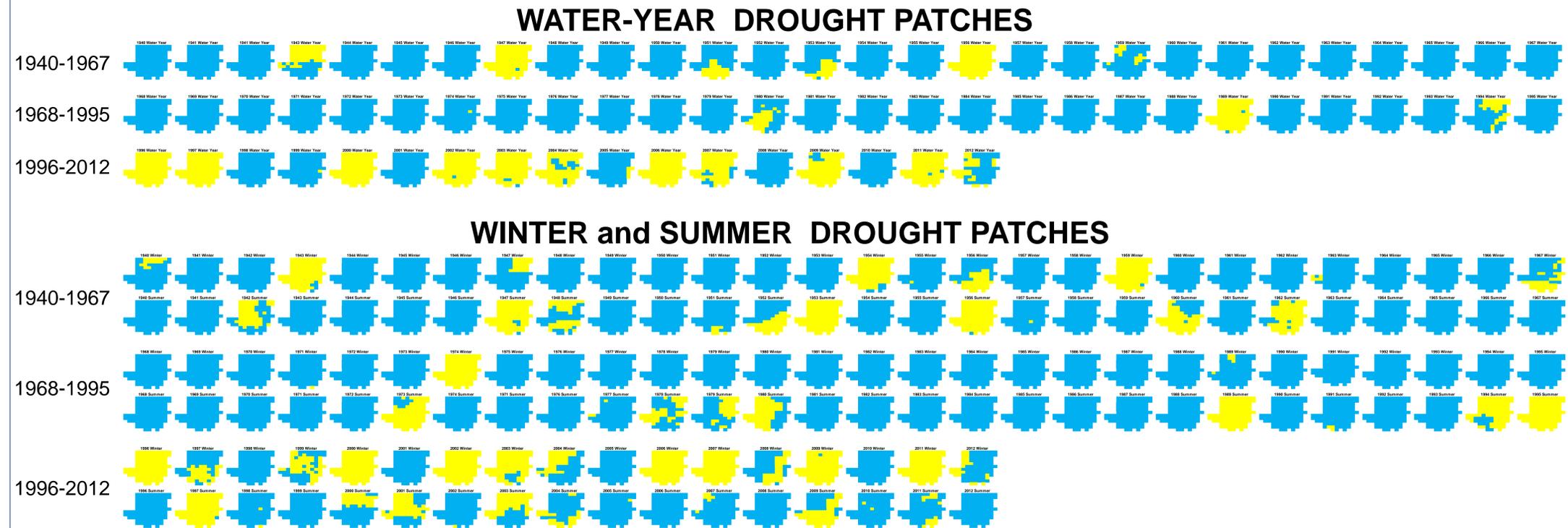


Table 1. Differences in water year, winter and summer drought patches after 1996.

Drought Patch Size	Water Year						Winter and Summer Seasons							
	<1996		≥1996		<1996		≥1996		<1996		≥1996			
	Frequency of years	Average Duration (years)	Maximum Duration (years)	Frequency of seasons	Average Duration (seasons)	Maximum Duration (seasons)	Frequency of winters	Average Duration (seasons)	Maximum Duration (seasons)	Frequency of winters	Average Duration (seasons)	Maximum Duration (seasons)		
0 Cells (No Drought)	0.82	0.24	4.18	1.00	14	1	0.72	0.24	3.52	1.00	16	1	0.54	0.50
1-2 Cells Small Pasture	0.18	0.76	1.00	2.60	1	6	0.28	0.77	1.29	2.60	2	7	0.39	0.58
3-6 Cells Water Unit	0.16	0.71	1.00	2.40	1	6	0.24	0.61	1.35	2.10	2	4	0.37	0.62
7-10 Cells Large Pasture	0.16	0.65	1.00	1.83	1	3	0.21	0.59	1.26	1.82	2	4	0.33	0.65
11-20 cells	0.14	0.65	1.00	1.83	1	3	0.21	0.53	1.28	1.50	2	3	0.35	0.72
21-50 cells	0.14	0.59	1.00	1.33	1	3	0.20	0.53	1.29	1.50	2	3	0.32	0.72
51-80 cells	0.07	0.59	1.00	1.33	1	3	0.13	0.35	1.17	1.20	2	2	0.21	0.75
>80 cells	0.05	0.59	1.00	1.33	1	3	0.11	0.27	1.20	1.00	2	1	0.25	0.89

SUMMARY OF RESULTS

1. Since 1996,
 - a. Drought is 2.5-12 times more frequent and up to 2.6 times longer
 - b. Drought patches the size of pastures and water units occurred in 59-77% of years, compared to 16-28% of years before 1996, and
 - c. Winter drought frequency increased 150-360%.
2. Drought frequency decreases as patch size increases, but the changes in frequency since 1996 were not uniform across sizes,
 - a. For Water Year (12-month), drought frequency increased 4-fold for most patch sizes, and 8-12 fold for the largest sizes,
 - b. For Seasonal (4-8 month), drought frequency increased 2.5-3 fold for all patch sizes, and
 - c. This resulted from a greater contribution of the large patches (>50 cells or 50% of SRER) of winter drought after 1996.
3. In response to these conditions, Managers should make efforts to detect the fine-scale pattern of drought, and increase flexibility in operations to avoid the drought patches.

Acknowledgements

Data from the SRER Digital Database, supported by USDA FS Rocky Mountain Research Station and University of Arizona. Funding from USDA-CSREES Conservation Effects Assessment Project (CEAP) Program.

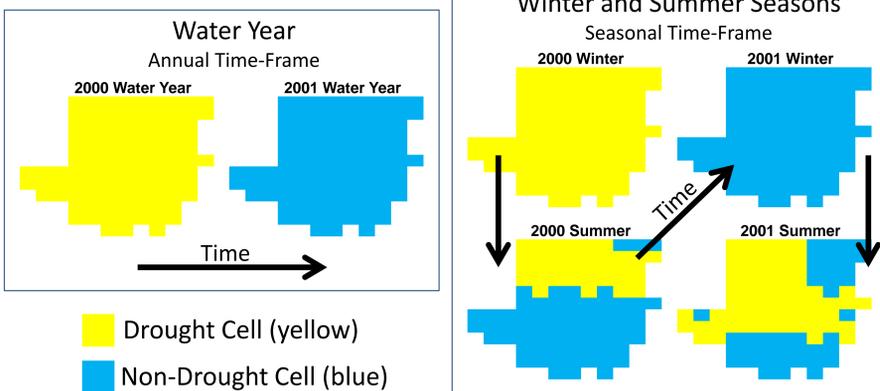


Figure 1. Distribution of drought patches across SRER in 2000-2001. Water year represents annual time-frame compared to winter-summer sequence representing the seasonal time-frame.