Drought Management: Similar Horizons but Different Perspectives

Justin D. Derner[1], Hailey Wilmer[1,2], Dannele E. Peck[1,2], and David J. Augustine[1]

[1]USDA-Agricultural Research Service, Rangeland Resources and Systems Research Unit, Cheyenne, WY and Fort Collins, CO, and [2]USDA Northern Plains Climate Hub

The expansive landscapes of Northern Plains states offer breathtaking horizons illuminated during sunrises and sunsets with a multitude of hues and shades of colors, intermingled with varying shapes, sizes and amount of clouds that give rise to inspiration and connection with the land for ranchers. Sunrises and sunsets offer changing perceptions of the natural beauty as unique textures and colors on the horizon change over time. As the dark landscape prior to sunrise becomes illuminated along the horizon by the rising sun, emotions and inner-feelings of renewal arise as a fresh dawn beckons our attention. Sunsets offer a glimpse of fulfillment and satisfaction from a day working alongside friends and neighbors to produce high quality beef for a growing population. The daily sunrise/sunset combination, repeating across seasons and years, provides each of us unique perspectives from these similar views of the horizon.

Drought management for ranches occurs across similar horizons of highly variable weather and climatic conditions. Droughts can be slowly emerging with advancing dry conditions marching across landscapes or they can be "flash" droughts that quickly develop (e.g., 2012 and 2017). This variability in droughts is combined with differing perspectives of individual ranchers and operations drought planning, risk tolerance, operational flexibility, and implementation of adaptive drought management strategies. Following are perspectives gleaned from two decades of collaborative research with ranchers regarding drought management in the Northern Plains. We conclude with tools that may enhance science-informed decision-making for ranchers.

Planning

A recent survey indicates that a majority of ranchers in Wyoming (60%, Kachergis et al. 2014) have a drought plan, but questions remain for implementation (1) is it written down? (2) has the plan been communicated to all decision-makers in the ranching operation, as well as with your banker? and (3) have key tactical and strategic dates for operation decisions been determined for retaining yearling steers (stockers), replacement heifers, culling dry cows, and early weaning? (Derner and Augustine 2016). Drought planning resources for ranchers are available at the National Drought Mitigation Center (http://drought.unl.edu/Planning.aspx).

Most ranchers (81%, Kachergis et al. 2014) prepare for drought using management practices that include (1) incorporating yearling livestock; (2) grassbanking (stockpiling forage); (3) stocking conservatively; (4) resting pastures; and (5) using 1 and 3 month weather predictions to adjust grazing management (Kachergis et al. 2014). Despite this planning, typical responses during a drought by ranchers include (1) purchasing feed; (2) reducing herd size; (3) earning off-farm income; (4) renting additional pasture(s); (5) applying for government assistance; (6) selling retained yearling livestock; (7) moving livestock to another location; (8) weaning calves early; and (9) placing livestock in a feedlot (Kachergis et al. 2014). Because many ranchers are responding to drought in a similar manner, market risks with livestock prices, hay prices, and pasture rent are heightened (Kachergis et al. 2014)

Operational Flexibility

Two key aspects of operational flexibility are (1) diversifying livestock production systems, such as incorporating yearlings with a base cow herd, and (2) larger ranch acreage, which enhances heterogeneity in the resource base and thereby enhances spatial flexibility in livestock movements as well as capacity for spreading risk over space. Recent economic models suggest that yearlings provide increased flexibility and profitability in variable climates (Ritten et al. 2010, Torell et al. 2010), especially when stocking decisions are adjusted using available forage and seasonal weather forecasts. Ranches that are larger use more drought management practices and have more resources to implement these practices; thus they have greater flexibility and experience fewer drought impacts (Kachergis et al. 2014). Conversely, ranchers with smaller acreages may benefit more from collaborating and coordinating with neighbors, as well as using social networks to improve resource accessibility and livestock mobility.

Adaptive Management

Adaptive management can be used to manage complexity through incorporating flexibility and feedback mechanisms using science-informed monitoring to help match forage production variability across years and within portions of a grazing season with animal demand. For management flexibility, four general strategies that ranchers can use to deal with drought are (1) predict it using weather and climate forecasting tools, (2) track it through adjustments in animal numbers, (3) employ conservative stocking rates, and (4) utilize inherent spatial variability (Derner and Augustine 2016). Adaptive grazing management plans on private and/or public lands should integrate drought prediction tools, conservative but flexible stocking, and existing and predicted spatial heterogeneity in forage quantity and quality into conservation practices where spatial heterogeneity in forage resources within and among pastures/allotments is often not explicitly monitored or considered when planning livestock movements.

Tools to Enhancing Science-informed Decision-making

To assist ranchers with reducing enterprise risk and increasing resilience of rangelands, several weather/climate forecasting tools are available. The US Drought Monitor (http://droughtmonitor.unl.edu/), released weekly, provides the spatial extent of abnormally dry to extreme and exceptional drought conditions. Further, monthly drought outlooks (http://www.cpc.ncep.noaa.gov/products/expert_assessment/month_drought.png) and seasonal drought outlooks(http://www.cpc.ncep.noaa.gov/products/expert_assessment/season_drought.png) provide maps with probabilities of spatial aspects of drought persisting, improvement from drought, and where drought development is likely. The value in these tools is that they do provide ranchers more information and at a fingertip with accessibility via mobile devices. Yet, ranchers should continue to use these tools cautiously and recognize that the provided information is imperfect and has a high degree of uncertainty. Moreover, the lack of sufficient soil moisture monitoring efforts limits application of many of these climate/weather tools to the scale of ranch-scale decision-making associated with drought planning.

Increased understanding of the complexity of longer-term climatological influences on drought provides insight for the spatial and temporal aspects of droughts. For example, the combinations of positive (warm) and negative (cool) regimes for the Pacific Decadal Oscillation (PDO) and the Atlantic Multi-decadal Oscillation (AMO) lead to contrasting spatial

configurations of drought across the United States (McCabe et al. 2004). During the Dust Bowl years of the 1930s drought occurred when both the PDO and AMO were positive (warm). In the 1950s drought had a similar positive (warm) AMO but a negative (cool) PDO (McCabe et al. 2004). This latter combination was prevalent over the 2000s, with highly variable conditions across years in the Central Plains and multi-year droughts in the Southern Plains. Both the PDO and AMO phases switched in the early 2010s with PDO (as of 2014) now in a warm phase (+PDO), and the AMO (as of 2013) in a cool phase (-AMO). These historical relationships suggest that drought frequency across most of the rangelands of the United States will be low, with the exception of the West Coast, and the northern tier of western states (most of Idaho, Montana, Wyoming, and North Dakota)(McCabe et al. 2004). Our rapidly improving understanding of how these decadal-scale oscillations influence drought risk in North American rangelands provides a context in which to assess risk associated with the more subtle textures of drought at temporal scales of years and seasons.

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