Forage and Cattle Response to Sierra Meadow Restoration

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1. Background

There is significant interest in restoring Sierra meadows that have lost hydrologic function. When the stream channel in a meadow down-cuts, or erodes into its bed, water table levels throughout the meadow drop and changes in plant communities occur (See transition of a meadow from a state of high to low hydrologic function in Figure 1). Plant communities shift *from* sedges, rushes, grass and clover species which require wet/moist soils *to* upland grasses, forbs, and shrubs better suited to dry soil conditions resulting from stream down-cutting and lowered meadow water table.

RIPARIAN AREA MANAGEMENT: ***A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas*** BLM/USFS/NRCS TR 1737-15 1998

State A – *high hydrologic function, wet and mesic plant communities, high water table*
State B – *impaired/at risk hydrologic function, mesic/wet, mesic, and some dry communities, dropping water table, eroding stream*
State C – *degraded hydrologic function, entrenched/downcut, dry plant communities*

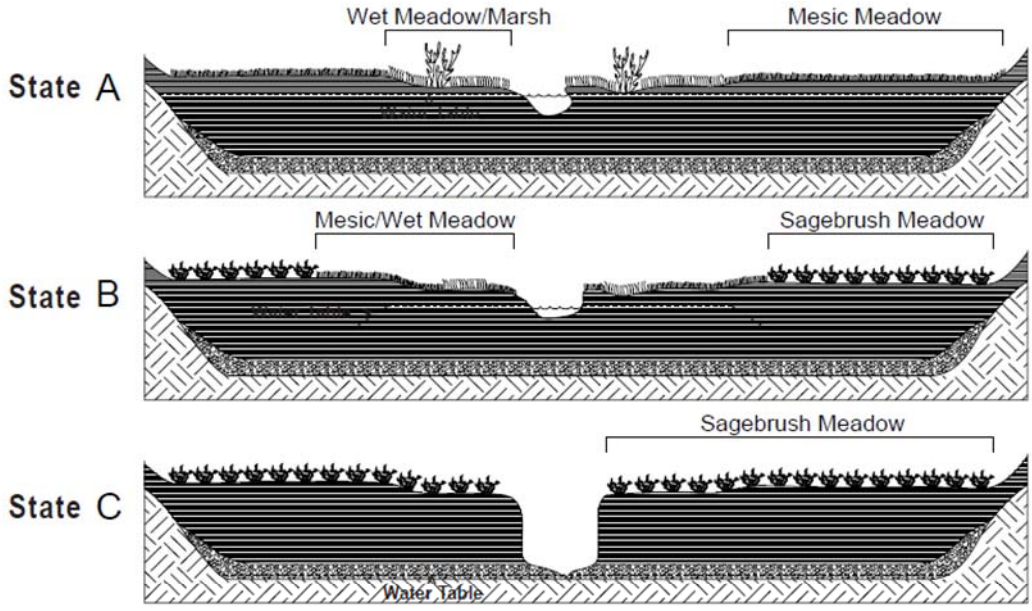

Figure 1. Illustration of the changes in stream channel depth, depth to water table, soil moisture, and vegetation types (plant community) which occur when a meadow stream channel down-cuts and meadow hydrologic function is diminished from State A to State C. *Adapted From BLM/USFS/NRCS TR 1737-15 1998*.

2. Objective

Our objective was to examine changes in forage quality and cattle performance associated with vegetation changes resulting from meadow down-cutting, and thus changes associated with restoration of meadow water table and wet/moist soil plant communities.

3. Approach – Step 1

Our first step was to organize our thinking about how changes in meadow hydrology (i.e., State A through C in Figure 1) would be related to cattle performance (See Figure 2).

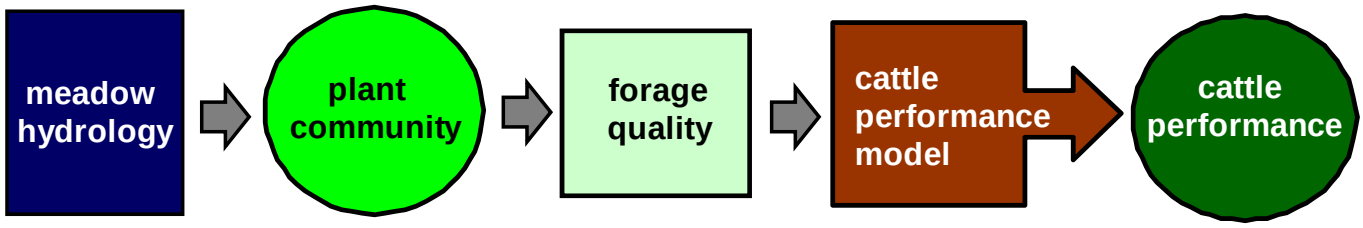

Figure 2. Conceptual model illustrating how we: 1) linked change in plant community to change in meadow hydrology from wet/moist to dry soil conditions; 2) linked change in forage quality to plant community shift from wet/moist to dry land vegetation; 3) input changes in forage quality to a computer cattle performance software (model) predicting cattle performance metrics based on forage quality and cattle class.

4. Approach – Step 2

Our second step was to use existing published information to describe/classify water tables, soil moisture, and key plant species defining plant communities conditions typically associated with wet, moist (mesic), and dry (xeric) meadows, or areas within meadows (Table 1).

	Key plant species	Moisture regime
Wet	beaked sedge, eleocharis, Nebraska sedge, scirpus, etc.	growing season water table +4 to -8 inches;
Moist	Kentucky bluegrass, tufted hairgrass, clovers, baltic rush, etc.	growing season water table -8 to -36 inches; adequate soil moisture most of season/years
Dry	Sagebrush, annual grasses, squirrel tail, etc.	water table deeper than 36 inches; inadequate soil moisture most season/years

Table 1. Our classification of plant communities (based on key plant species) and soil moisture regimes of typical wet, moist, dry meadows (and areas within meadows).

5. Approach – Step 3

Our third step was to use information from several of our research projects to estimate forage quality associated with wet, moist, dry meadow plant communities. We used forage quality information collected from wet/moist/dry meadow plant communities in Lassen, Plumas, Sierra, and Fresno Counties to estimate early (June-July), mid (July-August), and late (August-September) growing season forage quality conditions for each meadow hydrologic condition (Table 2).

Community	Forage Quality	Early	Mid	Late
Wet	Protein (%)	12-18	9-13	7-11
	ADF (%)	26-32	30-35	35-40
	P (%)	0.17-0.27	0.12-0.20	0.08-0.16
Moist	Protein (%)	12-22	11-16	8-13
	ADF (%)	22-30	30-35	35-40
	P (%)	0.20-0.35	0.12-0.22	0.10-0.20
Dry	Protein (%)	10-15	7-10	4-7
	ADF (%)	28-35	35-40	40-45
	P (%)	0.15-0.25	0.10-0.15	0.05-0.10

Table 2. Estimates for ***early*** (June-July), ***mid*** (July-August), and ***late*** (August-September) growing season forage quality conditions for wet, moist, dry meadow plant communities. ***Protein*** is crude protein, ***ADF*** is acid detergent fiber and is an indicator of digestibility (increased ADF indicates reduced digestibility), and ***P*** is phosphorus which is commonly deficient in cattle diets in the Sierra Nevada. All values are reported on a % of dry matter intake basis.

6. Approach – Step 4

Our fourth step was to use the information in Table 2 as input to computer software designed to estimate cattle performance metrics based on cattle class (e.g., stocker/yearling, mature lactating cow) and diet quality. We used Oklahoma State University – Cow-Culator (http://www.beefextension.com/new%20site%202/cccalc.html) to predict average daily weight gains (ADG) for stocker (calves less than 1 year old, but weaned from their mothers) on wet, moist, and dry meadow vegetation. The Texas A&M University Nutrient Balance Software (http://cnrit.tamu.edu/ganlab/pagesmith/7) is another option for this analysis. Stockers are only one example of the use of this approach. We assumed 45 day long early, mid, and late growing seasons. We assumed unlimited intake of forage by stockers across all three meadow plant communities. We estimated average daily gain for a single stocker (lb/day) during each season, the season total gain per head (total/hd), and the season-long gain and the monetary value (assuming $1.20 per pound) of the gain for an individual stocker (season-long) (Table 3).

We found regardless of meadow plant community (wet, moist, dry), the forage quality and resulting cattle performance declined as the growing season progresses. We found that moist meadow vegetation had the greatest overall forage quality and cattle performance, followed by wet plant communities. Dry plant communities resulted in substantially lower stocker gains and revenue (Table 3).

Community	weight gain	Early	Mid	Late	Season-Long
Wet	lb/day	1.84	1.68	1.27	
	total/hd	83	76	57	216 ($259)
Moist	lb/day	1.86	1.71	1.58	
	total/hd	84	77	71	232 ($278)
Dry	lb/day	1.74	1.27	0.92	
	total/hd	78	57	41	176 ($211)

Table 3. Stocker weight gain estimates for ***early*** (June-July), ***mid*** (July-August), and ***late*** (August-September) growing season on wet, moist, dry meadow plant communities. We estimated ***Weight gain*** as average daily gain per head (lb/day) during each season, the ***season total weight gain per head*** (total/hd) and the ***season-long gain*** and monetary value of this gain (assuming $1.20 per pound) for an individual stocker.

7. Preliminary Conclusions and Next Steps

The loss of water table and resulting transition from wet/moist meadow vegetation to dry land vegetation has real consequences for cattle performance and ranch profits. Restoration activities which return relatively shallow water tables and increase soil moisture in meadows will lead to plant communities which increase meadow forage quality and value for livestock production.

The magnitude of loss/improvement in cattle carrying capacity associated with meadow hydrologic function loss/restoration will be site specific, varying from meadow to meadow. Next steps in this project are to apply the cattle performance estimates for wet/moist/dry meadow conditions to several case studies. We also need to improve our estimates of intake by cattle, as it is likely that intake is lower on dry plant communities which would further widen the performance gap between moist/wet and dry plant communities. There are also ranch enterprise costs and benefits associated with meadow degradation/restoration which cannot be calculated in terms of pounds of gain per acre or per head. Factors such as increased/reduced management flexibility and availability/lack of high quality forage at key times can improve/reduce the ranch's overall bottom line. We intend to investigate some of these factors as well.

This handout can be found at: http://rangelandwatersheds.ucdavis.edu under "Recent Outreach"