Introduction to the Herbage Assessed Remotely to Predict Environmental Risk (HARPER) process

Overview:

There is an ongoing need for rangeland managers to assess mulch/Residual Dry Matter (RDM) retention levels on California Annual Grasslands in the fall time frame, prior to the rainy winter season. September-October mulch levels have been shown to be an important indicator of rangeland condition or status. Consistently low mulch levels can result in degradation of range condition and excessively high mulch levels can result in monocultures dominated by European annual grasses and reduced biodiversity.

Traditional monitoring strategies:

Traditional monitoring of California Annual Grassland mulch/RDM levels include both Qualitative and Quantitative methods. Most mulch/RDM monitoring programs involve extensive clipping and weighing of numerous small plots to obtain an average estimate of mulch/RDM retention. A problem with averages is that they do not identify problems associated with uneven distribution of mulch levels within a management unit (MU).

Measuring Utilization: Utilization measurements are based on the concept of proper use which is to utilize no more than a target such as 50% of annual growth. This requires caged areas to measure ungrazed growth which is then compare to the residual amount in grazed areas. Problems include the effort needed to move cages every year, and that during a drought year with low forage production, a 50% target use may be too much.

Measuring Residual Mulch/RDM Retention: Mulch/RDM retention assumes that there is a minimum amount of mulch/RDM needed in the fall to provide suitable germination of desirable annual grasses and forbs. University of California Cooperative Extension (UCCE) has developed guidelines for minimum mulch retention that consider slope, tree cover and site productivity. In practice most mulch/RDM monitoring projects include only a single minimum retention value for the entire MU even when the unit is complex with a variety of slopes. Problems occur if the minimum retention level becomes the goal. Averages do not provide information as to overall MU condition or status nor information as to where the areas of low or high mulch/RDM are located within a MU.

HARPER Process:

The Wildland Solutions HARPER process is a satellite-based assessment tool to efficiently monitor mulch/RDM retention on California Annual Grassland sites.

The HARPER process is designed to help answer three questions related to mulch/RDM retention levels.

1. **What is the estimated mulch/RDM retention level for all forage areas?**
2. **What is the overall condition/status of each MU? Are there large areas of unacceptable low mulch levels or significant lightly used areas with high levels of mulch?**

3. **What is the estimated range of available AUMs for each management unit when surveyed? Where are the areas of high mulch/RDM located?**

Current high resolution satellite imagery, 40 plots/acre, is used to classify mulch levels within each MU.

HARPER results are then provided as 2 maps and 3 summary data tables that assist the rangeland manger's ability to interpret and understand the data.

Question 1, regarding mulch/RDM retention levels information is displayed with Figure 2-Classified Mulch Retention Map and summarized with data Table 1-Mulch Retention. Information is shown as High, Moderate and Low mulch, plus Burned and Other (forest, shrub, facilities).

Question 2, regarding the overall condition/status of each MU is displayed with Figure 3-MU Status Map and summarized with data Table 2-MU status. Figure 3 and Table 2 are derived from the same data initially created for Table 1. The MU status is a measure of conditions that is not available when mulch monitoring is focused on average use or minimums. Historic information regarding MU status is also included in data Table 2 to help evaluate if current year results are recent or long-term.

Question 3, The estimated AUM's potentially available within each MU is displayed with Figure 2-Classified Mulch Retention Map and summarized as data Table 3-Available AUMs. The location of areas with high mulch levels can be determined by reviewing the mulch retention map, Figure 2. Estimates of potentially available forage is provided in Table 3 for each MU.

Examples of figures and tables created are provided on pages 5-7 of HARPER process guide.

There are 4 phases in the HARPER process:

> Preliminary Phase-
> > Setting up a project and establishing goals/objectives to be monitored.
> Survey Phase-
> > Data acquisition and creating a supervised classified satellite image.
> Analysis Phase-
> > Displaying the distribution of estimated mulch levels, calculating the MU status and estimating the available AUMs for each MU.
> Report Compilation Phase-
> > Presenting the results in a report format that assists rangeland managers in evaluating the distribution and status of mulch levels for each MU of the project area.

The same information, using both a visual display and numeric values, is used to summarize the classified area within each management unit in Figure 2 map and data Table 1.
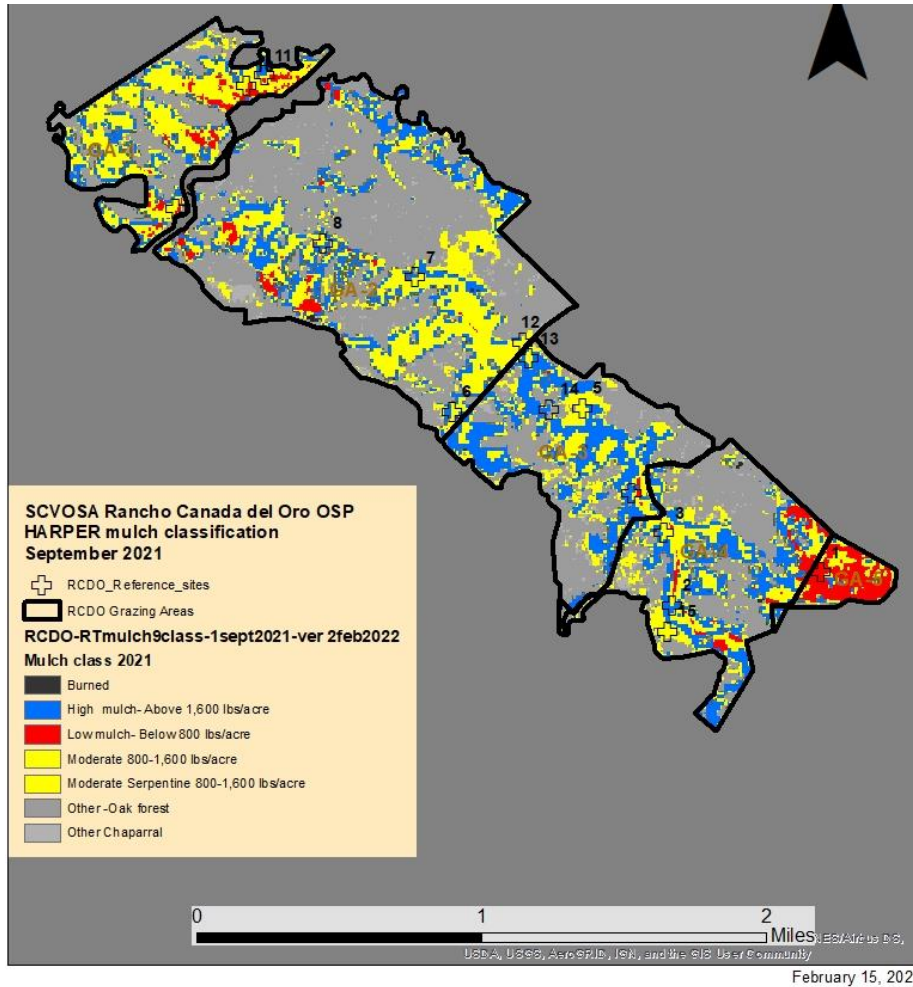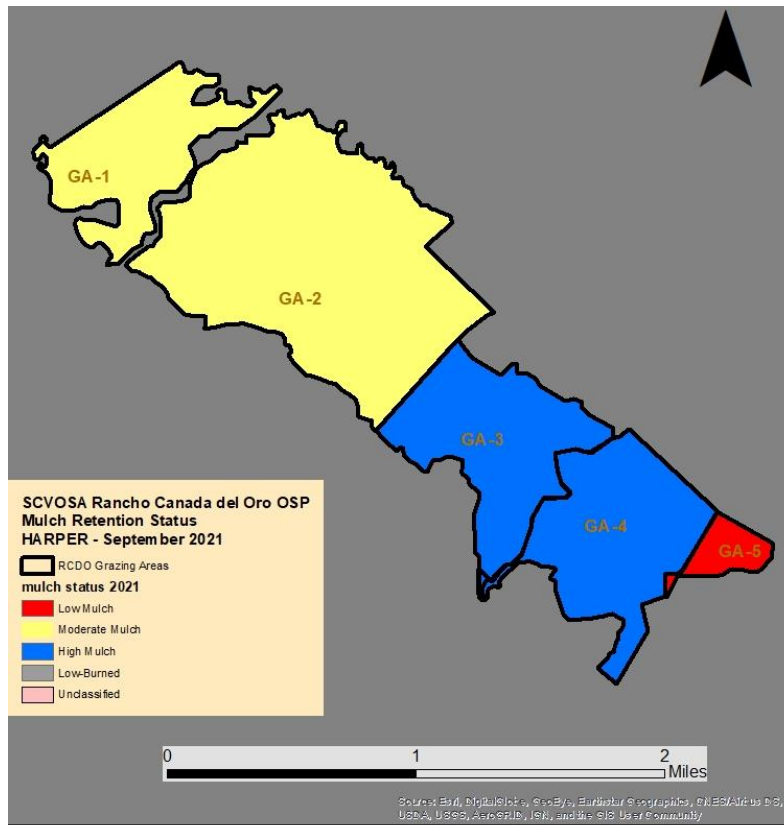

Figure 2B: Mulch retention classification
Rancho Canada del Oro 2021

Table 1 –SCVOSA RCDO 2021 Mulch Retention Classification

Management Unit	Total Acres	Classification of mulch levels as lbs./acre				
		% Low Mulch Below 800	% Moderate Mulch 800-1,600	% High Mulch Above 1,600	% Burned	% Other
RCDO – GA-1	204	6	40	15	0	39
RCDO – GA-2	623	1	22	14	0	62
RCDO – GA-3	252	0	23	30	0	47
RCDO – GA-4	262	4	25	24	0	48
RCDO – GA-5	39	62	25	8	0	6

The same information is used to describe the status for each MU/pasture in Figure 3 map and data Table 2. Historic information regarding MU status is also included in data Table 2.

Figure 3B: Mulch Retention Status
Rancho Canada del Oro OSP 2021

Table 2 –SCVOSA RCDO OSP 2017-2022 Management Unit Mulch Retention Status

Management Unit	Forage Acres	Management Unit Status							
		2017	2018	2019	2020	2021	2022	2023	2024
Total AUMs		??	??	??	??	??	??	??	
Rainfall as % of Normal		163	76	136	61	44	58	136?	
RCDO – GA-1	102	High	High	High	High	Moderate	Moderate		
RCDO – GA-2	189	High	Moderate	High	High	Moderate	Moderate		
RCDO – GA-3	106	High	High	High	High	High	Moderate		
RCDO – GA-4	114	High	High	High	High	High	High		
RCDO – GA-5	36	Moderate	Moderate	Moderate	Moderate	Low	Low		