Testing a Remote SensingBased Interactive System for Monitoring Grazed Conservation Lands

By Lawrence D. Ford, H. Scott Butterfield, Pete A. Van Hoorn, Kasey B. Allen, Ethan Inlander, Carrie Schloss, Falk Schuetzenmeister, and Miriam Tsalyuk

On the Ground

- Many public agencies and land trusts that manage grazing lands are interested in using remote sensing technologies to make their monitoring programs more efficient but lack the expertise to do so. In California annual grasslands, using remote sensing is especially challenging because the dominant vegetation is not detectable by standard technologies at a key time of year for monitoring.
- The Nature Conservancy of California (TNC) has developed RDMapper, an easy-to-use web-based tool that uses satellite-based productivity estimates, rainfall records, and compliance history to identify management units at risk of being below the required level of residual dry matter (RDM).
- TNC successfully used RDMapper in 2015 and 2016 to predict compliance across approximately 47,000 hectares of conservation easement grasslands, while reducing monitoring costs by 42%.
- We also applied RDMapper on six non-TNC properties (approximately 5,700 hectares) owned by two public agencies. We correctly predicted RDM compliance on 74% of the management units and found the method to be successful overall, with several challenges mainly relating to meeting RDMappers data requirements.
- Our study illuminated potential benefits, hurdles, and best practices for landowners interested in using RDMapper to increase monitoring efficiency and made recommendations to improve it.
- Adding RDMapper to conventional monitoring toolkits could be game-changing for public lands management agencies that currently struggle to manage vast grasslands.

Keywords: California annual grassland, RDMapper, residual dry matter, conservation easement, MODIS, time series analysis, decision-support tool.

Rangelands xx(x):1–10
doi: 10.1016/j.rala.2017.06.005

Nearly 11% (or 4.2 million ha) of California is occupied by annual grassland.[i] Of this, nearly 20% (850,000 ha) has legal restrictions to conserve open space or special resources, with over 200,000 ha in conservation easements and over 600,000 ha in fee title ownership.[ii1] Those grasslands that are publicly owned or have legal restrictions to conserve special resources are generally obligated to be monitored due to permits, easements, or public demand. The agencies and individuals responsible for monitoring the effects of grazing on these grassland habitats can face a daunting task. Conventional methods for collecting and reporting the required data and for providing meaningful year-by-year assessments of herbaceous cover (and, indirectly, its effects on soil conservation and habitat quality) tend to be time-consuming and resource-intensive, sometimes prohibitively so. Our team evaluated a new tool with the potential to significantly reduce the costs and improve the efficiency and accuracy of monitoring the effects of grazing, while also increasing opportunities for collaborative engagement among the parties responsible for habitat management. Developed by The Nature Conservancy (TNC), the tool—called RDMapper—tracks residual dry matter (RDM)

[i] California Wildlife Habitat Relationships System vegetation types in the Fire and Resource Assessment Program (FRAP) database of the California Department of Forestry and Fire Protection, California's forests and rangelands: 2015 assessment (http://frap.fire.ca.gov/data/frapgisdata-sw-fveg_download, accessed 3 Mar 2016).

[ii] California Conservation Easement Database, California Protected Areas Data Portal (http://www.calands.org/cced accessed 1 Jan 2017; California Protected Areas Database, California Protected Areas Data Portal (http://www.calands.org/data accessed 24 Mar 2017). Data are not available on how many hectares of California grasslands are grazed by livestock.

Figure 1. California annual grasslands with oak woodlands and chaparral (Santa Clara Valley in the distance to the west; photo by L. Ford 2016).

compliance, a key element of grazing-effects monitoring, with relative ease compared with other methods. Compliance refers to monitoring that shows results as good as or better than the performance standards set in advance. In doing so, TNC can identify areas in the spring that are at risk of failing to reach autumn performance standards, making it possible to focus limited monitoring resources on the problem management units. We tested RDMapper's effectiveness for monitoring RDM compliance on California annual grasslands at park and preserve lands of three agencies in the Coast Ranges of Central California.

The Santa Clara Valley Habitat Agency (Habitat Agency), at whose request our team evaluated RDMapper, was formed in 2013 to implement the Santa Clara Valley Habitat Plan (Habitat Plan).[1] The Habitat Plan provides a framework for permitting development projects in the habitat of endangered and threatened species. The Habitat Plan requires developers in these areas to avoid, minimize, or compensate for impacts to the special-status species habitat and special natural communities. The Habitat Plan includes two key approaches for protecting habitat: 1) bringing some habitat lands into public ownership, and 2) creating conservation easements on private habitat lands for their protection and management in perpetuity, as mitigation for habitat loss due to development within the covered region.

Grasslands cover 37,427 ha (20%) of the Habitat Plan Area,[1] in landscapes mixed with oak woodlands and chaparral (Fig. 1). These grasslands are regarded generally as "hotspots" of biodiversity.[2] A significant challenge for managers of these grasslands is the control of nonnative herbaceous vegetation, which, if left unmanaged, can reduce habitat quality for native species. Among the available methods for keeping nonnative vegetation in check and for sustaining grassland habitat in general, the most cost-efficient and effective—and likely to have the widest use—is livestock grazing. Two major alternatives, mowing and burning, are both very labor-intensive and therefore costly; also, both of these methods are restricted to small areas during the nongrowing seasons, and neither generates revenues for the property owner. Additionally, burning is uncommon because it requires obtaining permits from regional air quality regulators and coordinating with local fire management personnel. In contrast, grazing by cattle has the advantages of providing effective vegetation treatments in gentle and rugged terrain and generating lease revenues. Moreover, it can be provided by a rancher who will conduct supplementary stewardship services, including friendly interactions with agency managers and public recreational visitors.

Monitoring grazing management in California annual grasslands with conventional methods relies mainly on tracking RDM—the mass of dry herbaceous plant material remaining in the autumn, upright or on the ground,[3] before the first autumn rains and the start of a new growing season. RDM has a long history of use in California grassland systems. The University of California has developed performance standards for RDM monitoring that are based on a site's dominant vegetation (annual grassland, annual grassland/hardwood rangeland, or coastal prairie), percentage of woody cover, and slope.[3] Conservation land agencies, like those involved this study, often adapt the University of California standards to help address biodiversity protection goals. There are, of course, other important variables to monitor, but RDM is a near-ubiquitous, and sometimes sole, component of monitoring programs for these grasslands. RDM reflects the effects of plant production and grazing on soil cover and habitat conditions in a given area.[3] Although monitoring of RDM in California originally focused on