Rapid Assessment Methodology for Proactive Rangeland Management

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There is an increasing need for rangeland monitoring methodologies that provide rapid assessment of grazing conditions, with reasonable cost and labor requirements. Controversies and problems regarding livestock grazing management decisions on public lands have been on the rise during the past 15 years. Agencies managing public rangelands, primarily the Forest Service and Bureau of Land Management, are under increased pressure to be more proactive in their management decisions and to base these decisions on reliable quantitative data. These pressures have come from an affluent rapidly growing human population that demands high-quality recreation, aesthetic appearance, and abundant wildlife populations from public rangelands. Drought, enforcement of the National Environmental Policy Act, and the desire by ranchers to better manage their rangelands have further increased the need for quick, practical, low-cost, and rapid assessment methods for grazing management decisions.

In the late spring of 2002, rangelands throughout New Mexico were in the third year of severe drought (Fig. 1). In July, ranchers and agency personnel were facing important decisions regarding forage availability, carrying capacity, and length of grazing season on Forest Service lands near Santa

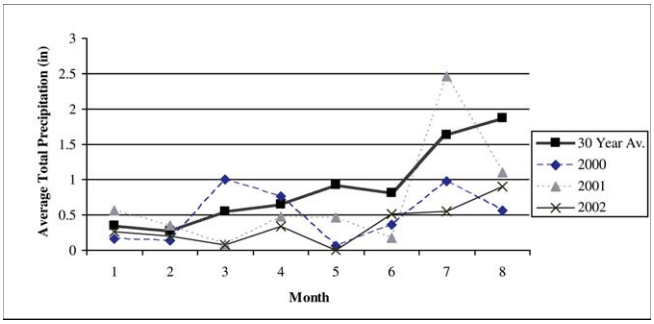

Figure 1. Total monthly precipitation (January–August) relative to 30-year average for 2000, 2001, 2002 at the Abiquiu Dam, New Mexico, Station from the Western Regional Climate Center. While not site specific, Abiquiu Dam is centrally located to provide an index of precipitation on allotments surveyed during 2002.

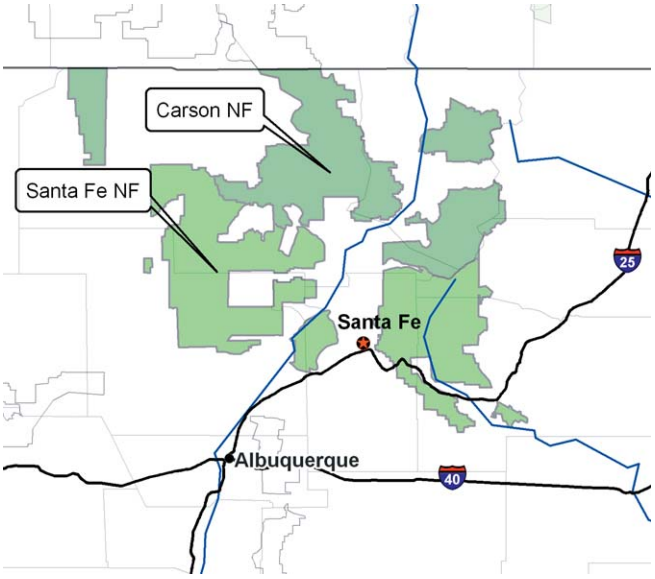

Figure 2. Map of the Santa Fe National Forest in New Mexico.

This article has been peer reviewed.

Fe, New Mexico (Fig. 2). Forest Service range personnel and grazing permittees contacted the Range Improvement Task Force at New Mexico State University. They requested that surveys be conducted to provide the basis for decisions regarding grazing duration and intensity on allotments comprising nearly 586,000 acres on the Santa Fe National Forest. These surveys involved 116 families on 25 different allotments and had to be completed in a matter of weeks. Seven teams (3 or 4 range science technicians each) were assembled to accomplish this mission. Prior to implementation of these surveys, the authors of this article met to decide what soil and vegetation characteristics should be evaluated to effectively assess range condition and grazing suitability in a short period of time. It was decided that the key area approach, coupled with any historical range transect that existed, would be used for surveys on each allotment. Cover, species composition, residual forage biomass, grass stubble heights, and photographs were used to characterize vegetation status. Pellet group counts served as an index of wild and domestic ungulate use. In order to assess potential plant growth, depth of soil moisture was evaluated at each site. In the remainder of this article, we discuss our specific rapid assessment procedures and their outcomes. We believe the approach we used has practical application for rangelands in other parts of the western United States and different parts of the world.

Rapid Assessment Methodology

Our rapid assessment methodology depended on proper selection of key areas. Key areas are an essential part of any sound rangeland monitoring program.[1,2] The key area is a portion of a range unit that, because of its location, grazing or browsing value, and/or use, serves as an indicative sample of forage production, trend, or degree of seasonal use. We used the following criteria and guidelines in our selection of key areas for monitoring on the Santa Fe National Forest.

Key areas were typically between one-quarter and 1 mile from water sources, on slopes less than 15%, on soils in satisfactory condition, and greater than 5 acres in size. Historic agency transect and cluster locations were evaluated for their potential as current monitoring sites. However, just because they were once historic key areas did not qualify them as current key areas. Water, fence, and road locations may have changed livestock distribution to make the historic sites poor locations for current monitoring efforts. These sites were evaluated individually and changed when deemed necessary.

There are no universal guidelines to determine the number of key areas to be monitored on a particular allotment or ranch. Differences in ranch size, pasture size, and site heterogeneity all combine to make such strict guidelines impossible. We attempted to install at least 1 key area for each range site or vegetation type on each allotment. However, in a few cases this was not possible because of time constraints, access, or other considerations. A total of 77 key areas and sites were sampled across all 25 allotments. Key areas were marked on a topographic or allotment map.

Figure 3. Sample key area used for rapid assessment methodology used on Santa Fe and Carson National Forests in the late spring of 2002. Erasable marker board with site labels are not included to maintain privacy.

We recognize that, ideally, monitoring should be conducted in autumn to determine net forage supply after the growing season. When possible, monitoring should also be conducted before spring green-up, when forage standing crop is at minimum. However, we designed the rapid assessment methodology to be used to provide quantitative information for adaptive management purposes at any time during the grazing season.

Photo Points

We used photo points to provide a visual qualitative record to support quantitative site data. We believe that 2 photographs should be taken at each monitoring site: 1 landscape-level photo point and 1 ground-level photo point. The landscape photo provided a panoramic view of the monitoring site (Fig. 3) and can be marked with a steel t-post. Approximately 15 feet away from the t-post, we propped up an erasable marker board so it could easily be seen in the photograph. Pasture name, photo point number, and date were recorded on the board. We also recorded the direction the photo was taken. We tried to include in the photograph some landmark, such as a rock outcrop or hill, so the same photo location could be used each visit. Technicians should have the previous year's photograph with them to more readily duplicate the photo. If no landmarks are apparent, we take a compass reading. We recorded the photo point site on a USGS topographic map or aerial photograph for future reference and recorded the GPS coordinate. We placed the ground-level photo point at least 10 feet away from the steel t-post in a location that is representative of the vegetation composition and ground cover.

Determination of Cover and Species Composition

We used the step-point method for determining plant cover and species composition.[3] We like this method because of its simplicity and reliability. It involves making observations along a transect at specified intervals using a pin or tip of the

Table 1. Critical stubble-height minimums for different categories of New Mexico forage grasses

Extra short ¾ inches	Short 1.5 inches	Short–mid 2.5 inches	Mid 4.0 inches	Tall 8.0 inches
Muhlenbergia torreyi	*Bouteloua aristoides*	*Agropyron cristatum*	*Aristida arizonica*	*Andropogon* spp.
Bouteloua gracillis	*Bouteloua gracillis*	*Agropyron smithii*	*Blepharoneuron tricholepis*	*Sporobolus airoides*
Hilaria belangeri	*Bouteloua hirsuta*	*Aristida*	*Bouteloua curtipendula*	*Sporobolus wrightii*
	Bromus tectorum	*Aristida pansa*	*Bromus inermis*	*Mulenbergia emersleyii*
	Carex spp.	*Aristida purpurea*	*Dactylus glomeratus*	*Muhlenbergia rigens*
		Bouteloua eriopoda	*Danthonia intermedia*	*Sorghastrum nutans*
		Hilaria jamesii	*Danthonia parryi*	
		Juncus spp.	*Deschampsia caespitosa*	
		Koeleria cristata	*Elymus elmoides*	
		Koeleria macrantha	*Elymus smithii*	
		Lycurus phleoides	*Festuca arizonica*	
		Muhlenbergia spp.	*Festuca thurberi*	
		M. montanus	*Muhlenbergia virescens*	
		Poa fendleriana	*Oryzopsis hymenoides*	
		Poa pratensis	*Phleum pratense*	
		Lycopodium selago L.	*Sitanion hystrix*	
		Festuca ovina L.	*Sporobolus cryptandrus*	
		Muhlenbergia wrightii	*Stipa spp.*	
		Agrostis hooveri Swallen	*Agropyron intermedium*	
		Bouteloua eriopoda	*Dactylis glomerata* L.	
			Schazachyrium scoparium	

Note: Use abbreviations for recording on data sheets. The first 2 letters of both genus and species is used (ie, *Muto* for *Muhlenbergia torreyi*).
Source: Holechek and Galt (2004).

boot to record "hits." Total cover, cover of individual species, and species composition were derived from the record of hits.

The initial starting point and direction of the step-point transect *should* be randomly determined (eg, randomly selecting a bearing between 1 and 360 degrees or simply using the minute hand of a wristwatch to determine the transect direction). However, we also used professional judgment to ensure that the transect did not intercept inappropriate areas (ie, roads, salting areas, etc.) and that it was representative of the entire key area.

To determine cover, observation points were made at paced (approximately 5 foot) intervals. Each step-point transect

had a total of 100 basal hits. At each basal hit, we recorded the cover type that bisected a pin or tip of the boot. We used 4 cover type categories, including litter, bare ground, rock, and vegetation. The basal hits were then recorded on the data sheet. If the basal hit was on live vegetation, then the species was identified and recorded on the data sheet. If the basal hit was not on live vegetation, then the nearest plant species was identified and recorded. A summary of the plant species present and relative composition based on 100 observations was provided for each transect.

Residual Forage Biomass

In order to determine residual forage biomass, we clipped a total of 5, 6- by 24-inch quadrats along the step-point intersect transect. The 5 sampling points were at the 20th, 40th, 60th, 80th, and 100th observation points along the transect. All palatable herbaceous forage plants (includes both grasses and forbs) within the 6- by 24-inch quadrat were clipped to ground level and placed into a paper bag. Experience and the site-specific foraging habits of livestock on the allotment determined which forage species we clipped. Clipping more than 5 frames per transect would be desirable. However, we recognize that increasing the intensity may dissuade range managers from collecting data or severely reduce the number of sites visited. Either of these results is undesirable, so we recommend that interpretation and analyses of data should take the small number of clipped samples into consideration.

Samples were then placed in an oven for 24 hours at approximately 60°C. This is important in order to standardize weights because percent plant moisture can account for a significant portion of the plant's weight and may vary drastically from one day to the next. Samples were then weighed to the nearest 0.01 g. A conversion factor of 96 (for a 6- by 24-inch sampling frame) was used to convert grams to pounds per acre.

We consider residual forage biomass important for avoiding harm to soil, vegetation, livestock, and wildlife. Across the western United States, on most sites, a minimum of between 100 and 200 pounds per acre of residual foraging matter is needed to sustain these values.[1,4]

Determination of Grazing Intensity

Because of its simplicity, reliability, and wide acceptance, we used stubble height of herbaceous forage grasses to assess grazing intensity.[5,6] We took stubble height measurements while evaluating basal cover using the step-point method. We implemented the stubble height method as follows. If the basal hit is on a grass species, the stubble height (average leaf length of majority of leaf blades) was measured using a ruler and recorded on a data sheet. However, if the basal hit was not a grass species, then the stubble height of the nearest grass species was determined and recorded on the data sheet. Mean stubble heights by species were then compared to stubble height guidelines developed for New Mexico rangelands (Table 1).[5,6] These guidelines describe the minimum advisable stubble height for continued livestock grazing. They are not intended for use as management targets but are thresholds below which grazing is detrimental to plants, livestock productivity, and site stability.[5,6] Leaf length should be measured by pulling leaves up (not by measuring in place) and estimating the average height (not longest or shortest) of the majority of leaf lengths. This approach standardizes the measurement and eliminates variability associated with weather conditions (ie, moisture, wind, etc.).

Our stubble height measurements were not converted to percent utilization. Similarly, frequency of use (ie, comparing number of grazed vs ungrazed plants) was not used to determine utilization or to measure range condition. As always, we stress that our purpose was not to determine grazing use but rather to avoid excessive defoliation that could cause long-term harm to grass plants.

Soil Moisture Depth

In order to make relative comparisons regarding potential plant growth between pastures or allotments, the depth of soil moisture was recorded at each monitoring location by digging a soil pit. A soil core was first removed using a spade or shovel. The depth was then recorded at which the moist and dry soil meet. Qualitative descriptions of soil moisture availability were then recorded (ie, wet to 3 inches, moist 3–6 inches, dry 6–12 inches). This information can be used to estimate the adequacy of soil moisture for plant growth.

Index of Wild and Domestic Ungulate Use

Pellet-group counts for elk, deer, and cattle were made within a belt transect. The belt transect was 6 feet on each side of the existing step-point transect (approximately 500 feet) used for vegetation sampling and was delineated while walking using a 6-foot carpenter ruler.

A minimum of 15 pellets of the same size, shape, and age were considered to be a group for elk and deer. At least 50% of the elk and deer pellets in a group had to occur within the belt transect boundary to be counted. The same 50% standard applied to cattle fecal groups. The number of cattle fecal piles also were counted within the belt transects. Each cow pie constituted 1 defecation event.

This particular pellet group method was not used to make density estimates for wild or domestic ungulates. However, this method provided a relative index of use by elk, deer, and cattle. It also provided an approximation of animal trends over time and a rough assessment of which animals were responsible for observed use. Because the defecation rate between elk (average 13 pellet groups per day)[7–9] and cattle (average 9 groups per day)[10,11] are not the same, they must first be standardized before any comparison can be made.

Data Interpretation and Decision Making

After data collection in the field, quantitative information was computerized and summarized for each allotment by Range Improvement Task Force personnel. Each allotment

Table 2. Rapid assessment information collected on the Santa Fe National Forest in July 2002 for proactive rangeland management decision making

Information category	Types of measurements	Managerial applications
	Plant cover	Soil stability, watershed health, rangeland
Vegetation	Species composition	Ecological condition, stocking rate, grazing
Assessment	Residual forage biomass	Use/intensity
	Grass stubble heights	
Soil assessment	Soil pit/core	Available soil moisture
Wildlife assessment	Pellet-group counts	Relative index or visitation of elk, deer, and cattle use
Visual assessment	Photographs	Aesthetic quality, watershed health, rangeland condition, grazing use

was then reviewed by the Range Improvement Task Force range specialists and placed in categories of 1) suitable for continued grazing, 2) unsuitable for continued grazing, and 3) grazing status required further review. Santa Fe National Forest range personnel were then contacted for review of information. A joint meeting was held between the Range Improvement Task Force and Forest Service range personnel for formal decision making. It was decided to conduct additional monitoring on allotments where uncertainty and disagreement existed over management actions. Permittees were kept apprised of progress in both monitoring and decision making.

Survey Results

Our rapid assessment of 25 grazing allotments on the Santa Fe National Forest in July 2002 found that 17 allotments had adequate forage to support full numbers of permitted livestock. These allotments were characterized by adequate amounts of forage standing crop (over 400 pounds per acre) and grass heights well above threshold levels. Depth of soil moisture indicated dry conditions on most of these allotments. Eight of these 17 allotments were selected for further reevaluation in September 2002. This was primarily due to standing forage levels only slightly above threshold values and/or lack of soil moisture. Continued livestock grazing with a reduction in numbers was recommended for 5 allotments. Overall, these allotments had grass stubble heights and/or forage standing crop at or near threshold forage levels. Soil moisture levels were generally low on these allotments. Follow-up monitoring was conducted on these allotments and revealed properly balanced forage supply and demand. We believe that our initial recommendations were appropriate.

No livestock grazing was recommended on 3 allotments. Key features of these allotments were grass stubble heights below threshold levels and inadequate standing forage crop. These 3 allotments all had wet soils. Average number of cattle fecal groups was 56% higher for allotments placed in "the unsuitable for continued grazing" category compared to those placed in the "suitable for continued grazing" category. Average elk and deer fecal groups were similar between allotment categories, although considerable variation occurred for elk within each category.

Management Implications

The rapid assessment methodology we developed and applied in our surveys on the Santa Fe National Forest in the late spring of 2002 enabled an integrated team of range professionals to make timely and critical grazing management decisions based on quantitative information on 25 allotments with severe drought. Our approach integrated a variety of well-proven monitoring methodologies into a practical framework. With the rapid assessment methodology, suspension of grazing occurred on only 3 allotments, whereas without the assessment, suspension was imminent on all 25 allotments. We believe the assessment helped to avoid resource degradation and sustain ranching enterprises in a multiple use context. The rapid assessment methodology has been employed since 2002 on several of the same allotments and has provided valuable baseline information for these subsequent efforts. In fact, the rapid assessment methodology has been requested on numerous occasions throughout the northern New Mexico region since 2002 and adopted as a collaborative approach to joint agency–permittee monitoring efforts. A list of the variables sampled using the rapid assessment procedure is provided in Table 2. However, the flexibility associated with the rapid assessment methodology also allows for increasing sampling intensity and the integration of other quantitative sampling methods depending on the monitoring goals and objectives. Therefore, we believe our approach and procedures have practical application on rangelands throughout the world.

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