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Cover Photo:

Stock grazing in Cyclone Meadows, Sequoia-Kings Canyon National Parks.

PROTECTING MOUNTAIN MEADOWS: A GRAZING MANAGEMENT PLAN

By Stephen H. DeBenedetti and David J. Parsons

For more than a century, pack and saddle stock have been used in the western United States for recreation and as a management tool. Today, most large western parks continue to permit the use of such animals for both purposes. The character of such use, as well as the management restrictions governing it, vary with the history of the area. In Glacier and Rocky Mountain NPs stock are required either to use corrals or hitchrails or to be tethered in designated areas. In addition, all stock feed must be carried into these Parks. In Yellowstone, stock is allowed to graze from picket lines in designated meadows that are rotationally rested depending on conditions. In California's Sierran parks, grazing by free-roaming animals generally is permitted. In Yosemite, stock parties are requested, but not required, to carry feed. In Sequoia and Kings Canyon, grazing by free-roaming stock is the norm.

Impacts caused by stock use are primarily a function of the timing, frequency, and intensity of use. Impacts result both from herbage removal (grazing) and trampling. Grazing occurs primarily in meadow or other forage areas; trampling impacts can be found associated with meadows, trails, or camps. The susceptibility of individual plant species as well as moisture conditions and phenological stage must be considered in evaluating the potential for such impacts. Behavior of the stock and control exerted by the packers also influence stock-use impacts.

Given the decision (whether for historical, political, or other reasons) that pack and saddle stock use is to be permitted, it becomes the responsibility of Park management to determine what levels of use and impact are acceptable. For example, grazing management policies should aim to minimize adverse impacts to meadow ecosystems. This generally means that the timing, frequency, intensity, and nature of stock use may need to be controlled. However, informed decisions on what specific restrictions should be enforced depend on knowledge about the effects of different use patterns and practices.

Private and commercial stock use has been common for nearly a century on much of the land now within Sequoia and Kings Canyon NPs. Recreational stock use peaked in the mid-1930's when 72 commercial outfitters operated in the southern Sierra Nevada. Dependence on stock now is associated with only about 6 percent of total backcountry visitor nights. Nevertheless, at least 16 commercial pack stations currently operate in the Parks. Commercial, private, and Park Service

administrative use now account for approximately 11,500 nights spent in the Parks by stock each year.

Starting with the work of Lowell Sumner in 1941, the NPS has conducted a series of qualitative surveys of meadow conditions in the southern Sierra Nevada. Reduction of vegetative cover, gullying and erosion, and the invasion lodgepole pine and "weedy" species were identified as serious impacts probably dating back to the late 1800's. Together with later surveys by Sharsmith (1959) and Sumner (1968), this information provided the basis for a grazing management program that has continued to the present and includes closing certain areas to grazing, restricting opening dates, and limiting the number of animals and length of stay. Management actions generally have been implemented on a case-by-case basis, most often only after the impacts have occurred. Together with evidence that subtle changes in species composition, abundance, and plant vigor have occurred with grazing, this has led Park managers to identify the need for more quantitative data on the impacts of grazing activities. Such data would permit the development of a grazing management plan that is both predictive and responsive to on-site conditions.

Development of the Plan

The first step is to establish management objectives. The objective for grazing management in Sequoia and Kings Canyon is to allow free-roaming grazing by commercial, private, and administrative stock, provided that:

- 1) continuous unidirectional change in plant composition and/or vigor (productivity) does not result,
- 2) the sod or soil does not become increasingly erodible, discontinuous, irregular, and
- 3) a network of meadows representative of each major type is protected from all stock use so that they remain as near to naturally functioning ecosystems as possible.



Clipping in simulated grazing plots

Other steps required in developing such a plan include a decision on the type of management system to be utilized and the development of a scientific data base on the effects of various grazing practices. In Sequoia and Kings Canyon, it was decided that the primary management tool would be a system of opening dates that would vary, depending on the type of hydrologic year and the vegetation and soils of the meadow in question. Additional restrictions, including closures or limits on number of head or duration of stay, would be utilized only on a meadow by meadow basis. Such restrictions might be based on total forage removed or the stage of development at which key species are grazed.

To meet the established objective, the Grazing Management Plan must provide a flexible system that (1) is sensitive to annual variation in climate, (2) considers the nature of specific meadows, and (3) is sensitive to the inherent ability of individual species to withstand grazing and trampling. Also essential is a monitoring program. The Plan must be sufficiently predictive to prescribe opening dates for specific forage areas in time for commercial operators to book their trips. The involvement of user representatives in the planning process adds greatly to the potential for compliance and acceptance.

Background Research

To develop a grazing management plan for Sequoia and Kings Canyon NPs, a 5-year research project was undertaken in 1973 aimed at understanding the composition, distribution, and susceptibility to impact of the Parks' major forage areas. The vegetation of each of these areas was described in sufficient detail to estimate the contribution of different plant communities to the total meadow acreage. A forage area was defined as a meadow or series of meadows and the dispersed forage in between that free-roaming stock would utilize when turned loose overnight from adjacent camp areas.

High-elevation meadows in the Sierra generally consist of a series of species groups, or plant associations, each with distinct characteristics (i.e. phenology, soil moisture, retention productivity, etc.) and tolerances to grazing and trampling. Such associations may be spatially distinct from one another (as along an elevation gradient), or they may be interspersed in a mosaic pattern, responding to such local environmental differences as surface irregularity. In the former case, animal behavior is often such that more sensitive areas may be avoided if preferred forage is available, for

Protecting Mountain Meadows (continued)

instance, in drier areas. In the latter case, animals often cannot avoid trampling the more sensitive areas. The potential for avoiding sensitive vegetation must be estimated for each forage area as the vegetation is classified.

In our study we looked at total productivity and phenology in conjunction with the effects of simulated grazing (clipping) on selected plant associations. The intensity (degree to which a plant is grazed), timing (stage of phenological development at time of grazing), frequency (number of times grazed during a season), and periodicity (pattern of grazing from year to year) of herbage removal have different effects on different species and, thus, on different associations.

Since it was not possible to test experimentally all of the potential combinations of these factors, we chose to look only at intense herbage removal (within 2.5 cm of the root crown or surface, whichever was higher). The timing of herbage removal was varied with calendar date, while frequency of grazing was simulated by clipping one, two, or three times during the growing season and again at senescence.

In all, we tested four clipping patterns, plus a control, for each of six plant associations. Treatments were repeated for four successive years to simulate severe repeated pressure. In the fifth year, recovery of the clipped plots was measured. The most important plant associations were replicated at several points along a 1,200 meter elevational gradient to evaluate the effect of elevation.

Results have provided us with basic knowledge of the annual fluctuations in productivity of the major plant associations present in the Parks' subalpine and alpine meadows. Response of the most important associations to sustained multiple clippings also has been determined. Thus, the effect of different levels of herbage removal can be predicted and capacities (in animal nights) can be predicted.

Trampling also may have significant impacts on meadow vegetation, in the form of direct injury or mortality or as indirect changes in composition of the kind that occur when surface moisture patterns or soil stability is altered. The Parks' objective has been to minimize the potential for changes in composition due to trampling by minimizing potential disturbances of the surface soil and sod. To accomplish this, moisture conditions were monitored in key plant associations on a regular basis (every 7 to 10 days) from mid-June through August, 1978-1981. In addition, the degree, extent, and type of mechanical impact, if present, was described and correlated to the moisture conditions. This provided a predictive index of susceptibility to trampling by

specific plant associations under differing moisture conditions. Such information provides the basis for estimating opening dates that minimize mechanical disturbance of the surface soil and vegetation.

Three important types of easily recognizable mechanical impacts observed were: (1) broken sod, which includes the imprinting, gouging, tearing, or shearing of the soil-vegetation complex, occurring most often when the surface soil is wet or moist; (2) scuffing, including the slicing or abrasive removal of aerial vegetation, occurring in mesic or drier sites; and (3) pulverization, the fragmentation or disintegration of the soil pedestal or soil-vegetation complex that occurs with severe trampling, most commonly under xeric conditions where vegetation is discontinuous.

While we feel the occurrence of broken sod can be minimized by means of adjusting opening dates according to moisture conditions, closer monitoring and additional restrictions may be necessary if pulverization or scuffing levels are considered unacceptable.



Enclosures used in clipping studies

Implementation of the Plan

Once the manager has information concerning the activity patterns of grazing animals, the composition of individual forage areas, the productivity of different plant associations, their responses to different herbage removal patterns, and their moisture regimes and susceptibility to mechanical impact, the tools are available to develop use prescriptions for individual forage areas that will have predictable results. The next step is to choose the degree, type, and extent of impact acceptable and adjust the intensity, timing, frequency, and periodicity of use accordingly. For example, a given forage area would have a specific opening date and may have limits on total stock nights, either for the year or

at any one time. These restrictions may vary depending on whether it is a wet, dry, or normal hydrologic year.

The grazing management system will succeed only if it can be understood by those who must use and enforce it. In Sequoia and Kings Canyon, opening dates are now prescribed for three types of hydrological years (wet, normal, and dry); thus it is possible for the user to know well in advance the opening dates for specific forage areas.

Once acceptable use prescriptions have been generated, the manager may find it necessary to ration or allocate use in strategically located or popular forage areas. Available options include head limits, length of stay limits, and scheduled closure periods.

Where levels or patterns of use are potentially unacceptable, it is necessary to develop an effective use-monitoring scheme. If biomass removal or the percent of preferred plants grazed is used to define acceptable use levels, either direct measurement of these factors, or estimates based on the number of stock days occurring must be utilized. Because of manpower shortages, in Sequoia and Kings Canyon we have developed an extensive use-monitoring system as an alternative to direct measurement. Administrative, commercial, and private stock parties are required to file an itinerary on completion of each trip. More than 90 percent of all stock use now is accurately reported.

As a final, important phase in our Grazing Management Plan, it has been determined that a network of meadows representative of the major types found in the Parks will be protected from all stock use. These natural functioning ecosystems have been selected so as to minimize inconveniences to users and to include as many remote areas as possible.

In summary, a grazing management system for free-roaming stock in western national parks must be based on clearly defined objectives and standards of acceptable impact. The vegetation and surface characteristics of each important forage area must be inventoried and response of specific plant associations to grazing and trampling known. Animal preferences and behavior may be important and should be evaluated. User characteristics and patterns in specific forage areas should be analyzed in order to develop the most appropriate management strategy where overuse might occur. A use-monitoring system also must be developed. The involvement of user groups in the planning process improves communications and assures that the manager has a clear understanding of the user perspective.

Parsons is a research scientist and DeBenedetti is a biological technician at Sequoia-Kings Canyon NP.