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# RANGE MANAGEMENT

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## Where Have We Been and Where Are We Going in Range Management?

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This paper deals with two aspects of range management: (1) an appraisal of the influence of research in formulating our present range management practices; and (2) the future research needs of the field of range management.

An optimistic outlook on the production from the Nation's rangeland in the next quarter century is held by many range technicians and graziers. As Renner (1954) has aptly pointed out, the outlook 25 years ago would likely have been on the pessimistic side. Up to that time little had been accomplished to curb the downward trend in range conditions and soil loss: reduction in livestock numbers seemed to be the only answer for correcting the adverse situation.

The timely financial help of the federal government to alleviate the plight of agriculture in the 30's; the organization of the Bureau of Land Management beginning in 1934, though handicapped by inadequate appropriations and personnel; and the lucrative market values of livestock that followed, had much to do with the improvement that has taken place. Indirect results of this governmental assistance were: the perfection of machinery for eradication of noxious vegetation, techniques for reseeding, the formation of large numbers of soil conservation districts on livestock ranch areas and elsewhere, and the assistance of state govern-

ments in innumerable technical and practical ways. Since 1930, range livestock populations have increased sharply. In future years, progress in range rehabilitation will depend upon the effectiveness of the research program and the extent to which the findings have been applied.

Looking ahead 25 years or so, indications are that many more animal products and foods of all kinds will be needed in this and other countries. With living standards continuously rising, and with populations increasing at rates not heretofore anticipated, demand for food, housing and clothing will increase tremendously. In 1950 the population of the United States was 150 million; in 1955 it is more than 160 million; and by 1975 it is estimated to reach 200 million.

According to the Mid-Century Conference on Resources for the Future, there is a note of pessimism as to whether the land can continue to produce to the extent that it has. Many feel that the world is already overpopulated and that the remaining acreage suitable for agriculture is relatively small.

### Range Reseeding

Reports on depletion of the western range mark the earliest welfare consideration of this resource. At various times during or even before the 1880's, reports of range depletion in the Southwest and elsewhere made their appearance (Bentley 1898, Bidwell 1865). These reports were so disturbing that, in 1900,

the federal government, followed by the state experiment stations, appropriated a small fund for range reseeding.

This study continued slowly over the years with indifferent results. It was not until 1935 that a large scale reseeding study was initiated. Recently, federal appropriations for reseeding have been among the largest for specific projects in range research.

Some 25 grasses and a few legumes, half of which have been introduced in recent years, have been found useful on the range (Hafenrichter, 1955). Study has also demonstrated how, when and where to seed promising species. As a result, a goodly number of ranchers have reseeded their own lands and many are obtaining larger yields and a longer green feed period than was possible with the resident species.

Certainly a good start has been made in the general procedure of reseeding, but much more study is needed.

Site quality is deserving of more critical appraisal which would involve: soil classification as to depth, pH and productivity; improvement of soils for grass production; further study of fluctuations in distribution and amount of annual precipitation; and further consideration of the indicator significance of native plants as related to site quality.

Better standards for appraising the degree of success of seeded areas are needed. Hull (1954), among others, has made a good start in this direction; but, perhaps the agronomist, ecologist, physiologist and soil scientist could combine their talents to formulate a more widely useful guide to reseeding appraisal.

Continued study should be made of the adaptability of introduced species as well as our native species.

1. Paper presented at the Eighth Annual Meeting of the American Society of Range Management at San Jose, California, January 27, 1955.

Since the resident species are well adapted to conditions within their range of tolerance, they present no special problem after establishment. Local strains or ecotypes of superior characteristics may be segregated and used for revegetation.

Critical study of the source of seed for planting seems justified. Earlier and larger yields of forage have frequently been obtained from seed produced 200 to 400 miles south, than from seed locally grown.

Breeding and genetic studies should be continued for the improvement of vigor, nutrition and yield and the development of early-growing and later-maturing forage plants. The chances of success in breeding forage plants should be as good as in cereal and orchard crops.

Paramount to all reseeding considerations are the costs and long-time returns on the investment. A much broader analysis of the economic aspects is needed.

#### **Natural Reseeding**

Grazing management systems, designed to build up and maintain the natural plant cover, should be further tested to ascertain the best system or combination for each grazing region.

On high mountain ranges, deferred and rotation grazing are accepted as essential to maintenance of ranges (Sampson, 1955). At lower elevations variable results have been reported from deferred-rotation grazing—some good, others of questionable application. Under southwestern conditions, a simplified-rotation system used by Merrill, 1954, gave a steady trend toward improving range condition and increased financial returns. Similar systems in other localities may give beneficial results.

Further research on grazing systems, particularly the deferred-rotation system, is needed in several climatic regions and plant associations, including the annual-type range of California.

#### **Brush Control**

From the earliest records of agri-

cultural pursuits, graziers in far-flung regions have had to cope with undesirable, aggressive, and often persistent woody plants (Shantz, 1947). Conditions over much of the western United States particularly favor the growth of brush.

Researchers of the last 15 years have made a good beginning in showing how woody vegetation may be controlled, including the big sagebrush in the Great Basin region, mesquite in the Southwest, and the chaparral found in California. Reseeding coupled with brush clearance is receiving much consideration by research workers and ranchers alike.

More information is needed on the causes of brush invasions into grasslands—historically, biologically and climatically. In the Southwest, mesquite is reported to be increasing faster than it is being eradicated.

The cost of brush clearance and of seeding is often prohibitive, chiefly because of the difference between the value of the site and the high cost of brush removal. For example, the cost of controlled burning of California chaparral is much higher than is generally anticipated; it is less for areas of about 400 acres than for smaller or larger areas (Sampson and Burcham, 1954). Certainly further study of the most economical size of brushfield to clear, and of keeping the area in a more useful kind of vegetation by whatever means, is justified in all the major brush-land types. Reliable means of classifying the quality of brush-land sites for profitable clearing have long been needed.

There is evidence that brush can best be controlled by a combination of methods. More selective herbicides, more efficient machinery for removal of brush, and the development of suitable plants for seeding brush-cleared lands are needed. A strong grass cover is a good deterrent to brush invasions.

Little information is presently available on the ecological life history of our dominant noxious brush species. Information is espe-

cially needed on: length of life; rate of growth; age when seed is first produced; amount, frequency, and viability of the seed crop; hazards during seedling establishment; natural enemies; trends in seasonal food reserves and sprouting characteristics when cut or burned.

#### **Range Fertilization**

It is evident that various range soil types may be low in one or more of the essential nutrient elements. Experimental trials have shown that nitrogen, phosphorus, and less commonly potassium, sulfur, and certain trace elements, are needed in some localities for maximum forage yields and desirable species composition.

Research should determine the nutrient deficiencies of various soil types and the economic returns to be expected from fertilizers. In some localities, selective fertilization of western rangelands has paid well; in other regions indifferent or negative results have been obtained.

In some areas of the annual-type foothill ranges of California, combinations of nitrogen and phosphorus have given increased yields and longer grazing seasons when applied under suitable conditions (Martin and Berry, 1954; Miller and Park, 1955).

Range fertilization should not be looked upon as a panacea for faulty grazing practices. It must be used with discretion if good results are to be achieved. It is significant, perhaps, that although fertilization tests were made on ranges in parts of the Southwest and the northern Great Plains Region before they were undertaken in California, results were not sufficiently effective to justify their use.

In further studies of range fertilization, the following items might well be included:

1. Fundamental investigations of fertilizer effects on various vegetational and soil types.

2. The influence of fertilizers on the nutrients content of forage plants. For example, can the phosphorus level in forage be raised

sufficiently by fertilizing to correct the deficit in phosphorus-deficient areas?

3. The relative proportion of the total range acreage to be fertilized in relation to particular livestock operations. For instance, on a cow-and-calf ranch producing feeder steers or on a ranch devoted to lamb production.

4. The effects of fertilization on the rate of range improvement, seed production and plant succession.

5. The economics of fertilization under various site conditions. Must fertilizers be confined to the more productive sites?

### Poisonous Range Plants

Although many range areas have improved in condition in recent years, the abundance of our poisonous plants seems not to have changed perceptibly. With somewhat better quality of forage and practical directives for minimizing plant poisoning, losses from this source are presumably less serious than a quarter of a century ago. It has long been recognized that the crux to minimizing losses from poisonous plants lies in the field of good range and grazing management.

During the past decade, the interpretation of a poisonous plant has been greatly broadened, largely because of the discovery of certain seasonally toxic substances in common forages. Plant species containing lethal amounts of nitrogen have occasionally accounted for heavy livestock losses. As, for example, fiddle-necks (*Amsinckia* spp.) and milk thistle (*Silybum maritimum*) in California (Bellue, 1952). Under certain growth conditions little understood, these and other plants may accumulate dangerous concentrations of potassium nitrate (Gilbert *et al.*, 1946).

Nitrate accumulation may be favored by applications of 2,4-D. In several instances, the leafage of sugar beets, after being sprayed with 2,4-D, has accumulated nitrate concentrations in excess of 8 percent, whereas, 1.5 percent is considered lethal (Stahler and White-

head, 1950). On areas containing abundant manure, such as holding pastures, nitrogen-accumulating plants tend to build up lethal levels of nitrate. Since the symptoms of nitrate poisoning are similar to those of hydrocyanic acid, the seriousness of nitrate toxicity has been underestimated.

More exploratory work is needed in coping with poisonous plants, particularly:

1. Additional toxicological study of such confusing genera as *Lupinus* and *Astragalus*.

2. Illuminating pictorial and popular descriptions of the more troublesome local species.

3. Descriptions of common habitats of species and study of conditions favoring lethal accumulations of such substances as hydrocyanic acid, nitrate, or selenium.

In this article Professor Sampson gives us in broad perspective the accomplishments in range management and the future needs of range research. It reflects the rapid growth and development of the science and art of grazing management.

4. Development of further practical guidance in preventive and remedial measures of plant poisoning.

Although ranchers are generally familiar with the food plants of their range, they often do not recognize the poisonous species. This local problem can best be corrected through the help of state and federal agencies.

### Grazing vs. Timber Reproduction

Soon after the creation of the U. S. Forest Service in 1905, study of the effect of grazing on timber reproduction was undertaken. The study revealed that on conservatively grazed areas damage was nominal—except in parts of the ponderosa belt of the Southwest where sheep were grazed (Hill, 1917).

More recent study on forest lands in the South has shown that close and unseasonable grazing by cattle resulted in destruction of many hardwood seedlings and even young trees by literally “riding them down” to make up for shortage of forage (Biswell and Hoover, 1945). Correction of this conflict in interests is being made by adjusting the grazing season to correspond with the period of adequate nutritious forage, and to avoid overstocking.

Conclusions from the studies concerning coniferous forests are of two categories: (1) those of general application, and (2) those applying to regional or more local conditions. General application is concerned with overgrazing, poor livestock handling, unseasonable cropping, and grazing by the wrong kind of livestock. Those of regional application are chiefly based on climate and extent of timber reproduction, the Southwestern forests being much more subject to damage than those of the Northwest or in Montana and Wyoming.

Future researches should be directed to a consideration of the following:

1. The relative palatability to domestic livestock and deer of the different species of coniferous and hardwood reproduction.

2. Extent of damage to plantations and farm forests from browsing and trampling of livestock and its economic consequences.

3. The control of damage by deer browsing and rubbing in forests and plantations in the eastern states where these animals are a pest.

### Range Utilization and Grazing Capacity

Improvement and maintenance of rangeland production are primarily governed by the closeness of grazing of the season's forage crop. Too close utilization results in decline in forage production; overly light cropping is wasteful of forage. The important question is: how closely may a range unit

be grazed without decline in forage yield or in lowering of its forage potential?

Recent researches have provided means of setting up standards of use for various—but not all—range associations and forage species, chiefly grasses. These standards—largely based on clipping experiments to stimulate grazing—serve as guides for judging proper range use and grazing capacity. The degree of utilization is expressed in percentage by comparing average stubble height of the key species with corresponding heights of the same species for which the “form factor” or height-weight ratios have been determined. From 35 to 50 percent of the current growth should usually be left ungrazed.

According to recent researches, range condition, or “health” of the range, is the state of productivity of the forage and the soil compared with the potential of an area when properly utilized. Condition classes are designated as excellent, good, fair, poor, or very poor; excellent being ideal, good as satisfactory, and the others as unsatisfactory. These classes are determined by density and composition of the cover, plant vigor, mulch and soil stability. Change from one condition class to another is indicated by trend in the succession. Overutilization causes the trend to decline downward, whereas proper utilization favors an upward trend or leaves it unchanged.

Stoddart (1952) and others have challenged the use of utilization standards because: (a) knowledge of the physiological endurance of plants to defoliation is largely lacking; and (b) the tremendous fluctuations from year to year in forage production on the western range render utilization standards all but useless.

Additional study of the two subjects under discussion is needed. Perhaps the following points might be worthy of consideration:

1. Enlargement of the study of utilization standards to encompass

important species of forbs, shrubs and grasses.

2. Determination of the food reserve trends for important indicator species that might be included in the utilization standards study. Studies should be made on ungrazed plants and plants defoliated in varying degrees, to simulate grazing.

3. Grazing capacity determinations in controlled experimental studies in the major range forage types. In each community where the experimental pastures are located, as suggested above, grazing capacity records—on ranges in good condition—should be compiled in cooperation with the ranchers. At present there is a distinct lack of grazing capacity history to draw on. The tests should be continued until conclusive results on proper use and grazing capacity have been established.

4. Coordinate methods of survey based on range condition classification by unifying present variations in methods of measurements, in rating of condition classes, and in estimating their grazing capacities.

### **Rangeland Erosion Control and Watershed Management**

The potential increase in range and forest products in past years has been offset in large measure by loss of soil resulting from thinning of the vegetal mantle. The sorting action on exposed areas of water and wind separates and removes the organic matter and the clay and silt fractions, leaving the soil in an infertile state (Stallings, 1950). Correction is slow and costly.

The multiple use approach of wildland management—providing water for the valley farmer and urban dweller, grass for the rancher, timber for the lumberman and game for the sportsman—has endured for many years, though not without argument. Indeed, it has become an established practice on diversified public lands.

Present knowledge of the rela-

tive effectiveness of the different kinds of covers—trees, brush, grass, leaves, litter and organic matter—on water yield and as protection against erosion, is limited. On experimental plots in California, for example, water yield is variable where brush has been removed, and seems to be influenced by the kind of vegetation and size of area cleared (Biswell, 1954). Since some soils erode more readily than others, those most subject to dislodgement need a relatively abundant cover. Range in good condition with near maximum density of desirable forage plants is generally associated with a stable soil. Range in fair to poor condition, with its typically incomplete plant cover composed largely of undesirable plants, is commonly associated with abnormal rates of erosion and poor watershed conditions (Ellison et al, 1951).

Various management guides or indicators may be employed to recognize downward trends in range condition and accelerated erosion.

Determination of accelerated erosion may be made by runoff plots and catchment tanks, or by a combination of indicators and inexpensive measurement devices such as developed by Gleason (11).

Future rangeland erosion control and watershed management research should embrace the following:

1. Both refined and broad biological and physical studies, including consideration of the economic feasibilities of engineering structure for critical areas.

2. Are there areas in the upper watersheds where dams and reservoirs would serve better than vegetal control?

3. Are the long-time values obtained from conversion of brush areas or of timberland to grass justified in the interest of soil conservation, forage production and water yield—especially on areas where grass does not occur in the successful pattern?

4. Are the greatest long-time benefits to range and watersheds

always obtained from practices that maintain a stable soil, or may non-conservation practices produce the largest benefits on some areas?

5. What impact has the land ownership pattern—federal, state, private—on soil erosion and water yield? Are there land units where change in ownership is justified?

6. Is there justification for the use of undesirable range plants like foxtail fescue, red brome, or mustard, which form a cover quickly to stabilize the soil, such as on burned-over brushlands in California?

7. What are the effects of controlled fires, fertilization, reseeding and subsequent range management practices on percolation, runoff and erosion?

8. Are ranchers and others justified in giving further support to studies of rain-making to favor the plant cover?

### Wildlife Management

Until 1930, management of big game animals consisted largely in applying a few regulations concerning the "take". Wildlife was considered a product of nature, not tied to the land upon which it lived. The regulatory measures resulted in vastly increased wildlife populations—in some localities well in excess of the food supply.

Present-day wildlife management considers this resource as a crop and aims to provide suitable local habitats for the desired species and adequate seasonal forage, water and cover. Specially designed surveys show the supply of food, forage utilization, the extent to which the animals are competing among themselves and with domestic livestock for food. The surveys also indicate the desirable size of the animal populations, and endeavor to develop effective principles in controlling wildlife numbers.

In some areas, protection is likely to destroy rather than to perpetuate the herbivorous game animals. The number and sexes of big-game to be taken must be decided on the basis of the adequacy

This issue is dedicated to the development and improvement of grazing lands throughout the world. Technical assistance programs and international cooperative efforts such as that of the Food and Agricultural Organization of the United Nations have forcibly brought to our attention the similarity in problems faced by graziers throughout the world and the common objectives shared by range managers in our own and neighboring countries.

The papers assembled in this International Issue describe the operation of the technical assistance programs as sponsored by the International Cooperation Administration and the FAO, and discuss the problems and management practices of several important grazing regions of the world.

In the first paper Wayne Miles of the Food and Agricultural Organization discusses the attributes and qualifications of technically trained men for international cooperation programs in range management. Prior to his Chilean assignment in 1953, Miles served with the FAO as a range management advisor in Israel.

Hugh M. Bryan and H. Wayne Springfield present the broad problems of range improvement in an arid land and the plan of attack as developed in the assistance program initiated under the former Foreign Operations Administration.

Techniques for evaluating grazing resources and for the stimulation of interest and awareness of the principles of range management are described in the articles by Barry C. Park and Marvin Klemme.

Z. Naveh, in charge of Range Research at the Experimental Farm Nive-Yaar at Rehovot, Israel, presents an excellent perspective of recent work in range improvement in a representative Mediterranean area. The paper was originally given at the Ankara meeting of the FAO Working Party on Mediterranean Pasture and Fodder Development.

The problems and progress in range management in an important South American grazing region are described by E. J. Woolfolk in a paper presented at the Eighth Annual Meeting of the Society in San Jose, California. Woolfolk participated in the 1953 International Pasture Management Course conducted by the Inter-American Institute of Agricultural Sciences, the Argentine government and the FAO.

of the habitat if catastrophe is to be avoided. On the other hand, supplemental feeding on winter range is being discouraged because of high cost and also because the over-utilization of natural browse adjacent to the feedlots.

Problems needing solution or further study in the interest of sustained game production include:

1. Determination of the graz-

ing capacity of wildlife ranges in relation to establishing optimum populations of livestock and big game. At present woefully little is known about carrying capacity for big game mammals.

2. Improvement in the methodology for obtaining adequate harvests of wildlife without sacrifice of recreational and aesthetic values.

3. Development of criteria for establishment of the economic val-

ues of game in relation to other land uses. This would entail further study of the comparative food habits of big game and domestic livestock.

4. Effective means of manipulating the habitat, particularly of brush fields and cutover areas, with a view of increasing food for wildlife.

5. Provision of technical assistance to ranchers for improvement of rangelands for wildlife as a source of income through hunting.

6. Study of the control of rodents and predators in the interest of wildlife and livestock.

### Range Animal Husbandry

A few readers will recall the gradual replacement on the range of the long-horned, long-legged cattle and light-shearing sheep of Spanish origin for animals of vastly improved conformation and usefulness. Federal and state organizations have assisted in the improvement in quality of range livestock. Such improvement in breeding herds and bands constitutes one of the outstanding achievements of range animal husbandry but much remains to be done.

The introduction and local breeding of Brahman bulls has resulted in measurably increased meat productoin in various parts of our warm, humid southern ranges as well as in some dry warm localities.

In sheep production not the least of the advancements are the cross-breeding experiments which have produced earlier and heavier lambs, and have shown how the basic breeding stock may be maintained.

Among the problems in need of further research, the following seem important:

1. Further advancement in breeding and selection to minimize range livestock losses from disease and parasites.

2. Development of less costly means of wintering livestock on open range or in the feedlot.

3. Further study of the palatability and nutrition of range forage, and the period when supplemental range feeding is biologically needed and is economically justified.

4. The relation of forage nutrition to abnormalities in livestock, such as "acorn" calves, decreased fertility, and the like.

### Resume

This, then, is a much abbreviated account of the influence research has had on our present range practices, and of the future needs of range research.

Perhaps an occasional look ahead is helpful lest we become overly complacent. Of one thing we can be certain: range research workers are not likely to run out of a job. From here on, however, because of the more technical problems arising on every side, better trained men will be needed. For this we must not only lean on the colleges and universities, but we must do a better job of familiarizing educators with the nature of our problems. Only in that way can we, as range managers, have a part in shaping curricula the better to meet the educational requirements of our research personnel.

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