between estimated and clipped yields showed that estimates were slightly smaller but less variable than clipped yields. Reasons for this were: examiners clustered their estimates about the mean; they underestimated high-yielding plots 16 percent while they overestimated low-yielding plots only eight percent; and they occasionally overlooked small plants.

Important advantages of the micro-unit method include: accurate estimation of yields; use of estimates which can be quickly verified by clipping; and use of small plots which can be delimited rapidly, studied intimately from one position, and caged economically. The main disadvantage to those not familiar with estimating will be the initial development of estimating skill.

The micro-unit method is not a panacea. Until a forage measurement technique is developed which is completely objective and which can be used by inexperienced examiners, the micro-unit method should have a place on many western ranges.

LITERATURE CITED


Our Native Range—A New Horizon in Soil, Water and Plant Conservation

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The National Association of Soil and Water Conservation Districts, and each district supervisor, has a distinctive role in eventual multiple use management of the Nation's native grazing resources. The immensity of that role, as related to land area and the Nation's economy, is exemplified by these facts: grazing is the largest single use of land in the U.S.; grazing land covers half the Nation's land area and three fourths of this is native range in the West and South; these lands furnish forage for over half our beef cattle and three fourths our sheep for about six months each year and, in addition, provide for nine million big game animals; practically all these lands have watershed and recreation values in addition to grazing; about one-third of these lands are commercial and non-commercial woodlands from which wood products are, or potentially may be, important.

Soil conservation districts need not contain native grazing lands to be directly concerned with the range conservation program. Many districts in the West, composed entirely of irrigated farms, are strictly dependent upon watershed values of native grazing lands in other districts many miles distant. Water, the most critical of all natural resources, makes the watershed values of all grazing lands of prime importance to everyone, and particularly to city folks.

Recreational values of grazing lands, too, are important and of concern to almost everyone. Grazing values of distant rangelands concern farmland districts because farmers commonly rely on rangelands for feeder livestock through which they market a wide variety of farm products. Red meat production from our grazing resource and a healthy range livestock industry definitely are essential to a sound national economy and are becoming more important as we experience population expansion and greater demands for these foods. Nearly all soil conservation districts have a direct interest in the wise use of the native grazing resource.

The N.A.C.D. through public land, watershed, research and other committees at state and

1Presented to the National Association of Soil and Water Conservation Districts in Denver, Colorado on February 6, 1963.
national levels, has demonstrated awareness of the need for stepped-up conservation activities on range lands. District supervisors and agencies have learned a good deal about the sound principles of a comprehensive and coordinated approach from the “pilot district” program of years ago. More recently, strong steps have been taken to intensify attention to range, indicating acknowledgment of significant changes which are taking place. Almost explosively, camping, hunting, fishing, boating, rock collecting, week-end ranching and other uses are becoming sources of supplemental income from private grazing lands and are demanding uses of public grazing lands. There have been and probably will continue to be conflicts between such recreational interests and grazing, watersheds and wood production. Who is interested in these newly glamorized products from range lands? Almost everyone of every age in the Nation. The whole populace seems to be getting into the show. People who never have and probably never will get out into the “wilds” dream of a vacation on which they can imitate the pioneers. With intense lobbying, these folks can become strongly biased voters favoring all kinds of unsound proposals that seem to bring their dreams closer to reality. Range scientists and technicians, the range livestock industry, and dedicated groups such as the N.A.C.D. are squarely in the middle of a situation that is both complex and urgent. Individually and collectively, we need to help the general public learn the truly sound relationships that recreation, wildlife, watersheds, wood production and domestic grazing must have to each other in this era of multiple use management. The need for general education about the range resource has never been greater. District supervisors throughout the Nation have an unusually fine opportunity to do this as they discuss conservation generally in their communities and develop district operation plans.

The American Society of Range Management hasn’t been asleep on this matter of informing the general public about our range resource, believe me. Quietly, and I’m proud to say, in an effective manner, we have accomplished much. Our major projects are pointed toward obtaining a more equitable understanding of the range resource and of the range livestock industry within the Nation’s economy. Our educational efforts have been primarily with pre-college and college youths, teachers, urban folks, other scientific organizations, groups representing other range uses, people from other countries, and our own scientists and ranchers. We are trying to expand the concept that the range resource can be improved and grazed perpetually by domestic stock and, at the same time, produce high quality watershed, wildlife, recreation and, where suitable, forest products. Scientific range management stands on the premise that this can be done.

To better understand our role in this mutual problem, let me briefly sketch what The American Society of Range Management represents. Its membership is composed of people representing a variety of interests, all centered around grazing land management. Researchers, technicians, administrators, bankers and business men, educators, students and ranchers naturally are interested in exchange of knowledge and the search for facts. Government agencies do not control the Society nor any of its projects or activities. Democratic processes involving multiple judgment of all members are strictly employed. The Society strives to prevent unbiased evaluation of facts for the public’s consideration. We have a single stated object which we follow to the best of our ability: to foster advancement in the science and art of grazing land management.

Ranchers make up over twenty percent of our membership and constitute the largest single-interest group in the Society. Ranchers regularly are elected to serve as officers at both the Section and Society levels. For example, two of fifteen presidents of the Society have been ranchers. In fifteen years, ten ranchers have served on the Board of Directors. One or more ranchers has been on the Board every year except two throughout the Society’s existence. Many of the rancher members are S.C.D. cooperators.

Rancher members make an extremely important contribution to the Society’s program. In a professional way, they provide the practical experience and industrial judgment essential for a balanced Society. The increasing number of ranchers and their retention of membership year after year indicates that the Range Society is functioning effectively as an unbiased professional organization.

It is of interest to note that the heads of three Federal agencies which deal with range management are members of the American Society of Range Management; Karl Landstrom of Bureau Land Management, Don Williams of Soil Conservation Service, and Ed Cliff of the Forest Service. Cliff is a Charter member.

Our objectives as far as range management is concerned, seem to dovetail perfectly. Soil conservation districts and the American Society of Range Management have much in common.

As we move toward this new horizon in soil, water and plant conservation with the intention of elevating our native grazing lands to a more equitable status
Economics

First, consider the economic values involved. Severe climatic and soil conditions typify much of the Nation's range area. It is poor land generally, from an agricultural viewpoint. Cost-benefit ratios for investments in range improvements and range management seem to be relatively low; however, they really are rather favorable. Amortization of range investments at a reasonable interest rate generally requires more time than do cropland investments. Federal cost-sharing and, in some instances, long-term financing has helped ease this situation. The average range livestock rancher, however, is forced by today's economic pressures to place a rather low priority on range projects and delay them so long as he has farmland projects which pay off greater, or at least faster.

Economics come in for early consideration in sound range management and development and we ask "Are the needed practices and measures worth the chips?" Some of our neighbors, after driving through the West, probably wouldn't think they are. They often comment on the extensive "worthless wasteland" they have driven through. Such comments indicate that these folks—the general public—have very little appreciation of the real economic value and practical usage of grazing lands and watersheds.

Innumerable ranchers throughout the Nation's range area will attest the fact that range conservation is economically sound, provided it is applied scientifically and practically. There are some areas, of course, in which Nature always seems to be totally adverse to man's efforts.

In today's economic evaluation, we need to sharpen our thinking on how to assess the value of the forage from range--land, particularly under multiple use management where grazing is only one use of the land. The crop from grazing lands generally is considered to be the animal products that are derived from the forage. Pounds of animal gain is used to express relative economic yields from range. Certainly, one important payoff to range development and conservation is increased quantity and quality of animal products. The program either measures up in this manner or ranchers won't buy it, nor could they afford it. Basically, however, this concept involves a faulty technique when it comes to studying the value of the range crop itself. There is a variable manufacturing process—the animal—involves between the forage produced by the land and the animal product sold. The animal is not merely a means of harvesting the range crop, such as a combine would be with a grain crop. There can be more inherent difference, for example, between two beef steers and their efficiency on the range than there is between two levels of range management. In addition to inherent differences between animals, we know relatively little about how such factors as temperature, wind, sunshine, flies, ticks, water distribution, topography, range sites, and even individual range riders, singly and in combination, influence the performance of animals from season to season and year to year within the same pasture. On the other hand, we are learning a great deal about the influence of range condition, climate, range site and soil on the production of range forage. Without detracting from the study of animal products as an economic factor, we need to focus more economic attention on the forage and the land in order to better understand how to measure the value of range-land production.

The need for bringing the land itself into the picture more strongly is emphasized where both wood products and grazing constitute the main marketable crops, and watershed, wildlife and recreation values also exist. Progress toward solving this economic puzzler will result if we remember that the value of the forage must be assessed, because it is the crop produced by the land to which conservation measures are applied.

Inattention to the Resource

Range as a resource and range management as a profession generally have been treated as afterthoughts in agriculture or farming, or merely as phases of forestry. In some instances, Federal, State and County agencies have subordinated the native grazing resource to a very minor role, even actual abuse. Some of this is still going on. The concentrated attention of some ranchers to scientific animal nutrition, livestock breeding, farm crops, marketing, transportation—all of which are vital to a successful ranch operation—but with little or no attention to scientific range management, has contributed to this lowly status of the range resource. Many soil conservation districts have pushed range development and conservation as a normal part of their balanced programs. Others, I'm sorry to say, have been terribly lop-sided in their over-emphasis
on farm crops, drainage, equipment work and so on, while neglecting the range resource which must be managed wisely in a stable local economy.

If my home state, Oregon, is typical, and I think it is, the situation is improving tremendously. Oregon's state soil conservation committee and state association of soil conservation districts are focusing attention on the range phase of conservation. This probably will influence agencies as well as ranchers to sharpen their attitudes toward range conservation. I look for our districts to line out the various range programs so that all their traces are pulling, at least most of the time and in somewhat the same direction.

**Land Ownership**

Land ownership has retarded the range conservation program, generally. Much of our native grazing resource, particularly in the West, occurs in a complicated ownership pattern. A variety of Federal, State and County lands, together with deeded and leased private lands, commonly constitute the year-long grazing resources of a ranching operation. As you know from your own experiences, the application of conservation measures on one portion of a ranch or farm generally requires temporary adjustments in the management of other portions of the place. Such over-all analysis, instead of a disjointed approach, is one of the strongest factors of a conservation plan. Ranchers, wanting to carry out conservation on private land, haven't been given an enthusiastic reception, exactly, when they asked for temporary adjustments in their permitted use of public lands that were needed before they could proceed. As segments and instruments of the Nation's total conservation effort, I think it is time that public agencies realistically support the effective coordination of conservation programs on land in all types of ownership. We need to stop thinking and acting as if the rancher's program was segregated in one basket and each of the various Federal, State and County programs were in separate baskets. How can we obtain an adequate national conservation program within a reasonable time and for a reasonable cost under such disjointed circumstances?

**Nature**

The nature of the rangelands and range science itself is complex and has retarded range conservation. Studying the secrets of range is unlike a test-tube science in which man can control every situation perfectly. The plant-producing forces of Nature such as soil, rain, wind, snow, sunshine, temperature and time, coupled with a complex history of fire and grazing, sometimes cause extreme variability on rangelands, even within an acre. One range pasture on a typical ranch in some areas of the West can represent more natural variation than exists in all the arable bottomlands of a whole river system. Furthermore, these same forces vary individually and collectively from season to season and year to year. This constantly changes the make-up, vigor and performance of the plant community. What we think of as a stable, high quality range crop is highly variable compared with a uniform farm crop.

**Range Workers**

Procedures for revealing scientific facts about the native range, as well as learning how to apply them to the land practically, are slow processes. They need to be studied and tested over a period of years in order to account for Nature's variables. The present lack of range scientists and technicians who actually work toward this end has seriously retarded the advancement of range science as compared to other biological fields. N.A.C.D.'s current "grass-roots" appraisal of the eleven western public-range states certainly will focus attention on range conservation throughout the West. Provisions should be made now to keep range science and technology abreast or out in front of this expanding program, if at all possible. Being unable to move ahead because of financial difficulties can be irritating. Not knowing what to do, however, is much more serious and causes waste of conservation funds, effort and time. In conjunction with any "grass-roots" appraisal, I hope agencies will see fit to intensify their contributions to range science and technology by re-assigning some competent, range-trained people who now concentrate on land adjudication, timber sales and work unit conservationist duties.

We have very much to learn about range science and its application. At the same time, we must realize that there is available a great wealth of practical range management know-how, based upon range and related sciences, which isn't yet being put into use generally by range livestock producers.

**Piece-meal Practice Application**

Range conservation is not merely fence building or water development, brush spraying or range seeding any more than land leveling alone constitutes a sound conservation program on farmland. Piece-meal installation of such range improvements, without dovetailing them into an over-all plan and without scientific range management, can be more detrimental than beneficial. Unfortunately, some agency programs and personnel have functioned in a manner which encouraged piece-meal application of practices. Scientific range management and over-all planning have been ignored. Consequently, the Nation has not attained as much effective conservation on native grazing lands.
as all the reports of practices applied and dollars expended might indicate.

**Grazing Tenure**

Insecurity of grazing tenure on public lands certainly must be noted as a major factor which has seriously deterred over-all range development and conservation throughout the West. Putting range conservation into practice requires investments of time and money, and changes in operating procedures, all of which can impose temporary hardships on the rancher. These investments are motivated primarily by the anticipation of economic gain or of a more stable enterprise. It is also known from experience that Government personnel and funds alone will not achieve a sound conservation program. The practical experience and full collaboration of the rancher is absolutely necessary. These facts, proven by years of experience on private lands in soil conservation districts, apply equally as well on public lands.

Effective and efficient conservation and development of our public range lands would be expedited markedly by an increase of the ranchers' role in those programs. Reasonable, economically sound benefits, including stability of grazing tenure, accruing to the ranch operation in return for the rancher's contribution on public lands, are proven motivations for accomplishing this desirable speed-up and economy of conservation. In order to put into effect a stable, practical comprehensive range conservation and development program, economically in line with the value of the resource, the whole Nation needs to rely heavily upon our range livestock ranchers. They are living right out on the land and personally helping to work out practical application of scientific range management today, tomorrow and always—rain or shine, just as they are on private lands. It would be ridiculous to try to get this gigantic job done solely with Government funds and personnel. Neither can we expect timely success nor program stability if we place too much emphasis and authority on range practices which tie only periodically to conservation programs, and then mainly during nice tourist weather or hunting seasons. The whole philosophy of range management needs to be changed from outmoded regulation to modern improvement; from segregated programs to teamwork. We will then be amazed at how much true conservation will be achieved by both the public and private conservation-dollar.

The six major aspects briefly cited as having retarded today's range conservation programs are: non-glamorous economic returns; general inattention to range science and the range resource; complexities of Nature, land ownership and range studies; lack of range workers; piecemeal application of practices; and unstable grazing tenure. Some might consider this frank summary of problems as a negative approach. I do not. Optimum program improvement can be obtained only after ferreting out the major points needing attention and then concentrating on them first. Generally, these aspects of the range conservation program will be found at the district, state and national levels. I hope an awareness of them strengthens the hand of leaders in the conservation movement and helps overcome their retarding effects.

The complexity of this whole situation of people, land use, interests, and land ownership makes it mandatory that the over-all resources with which we have to work be understood. N.A.C.D.'s "grass-roots inventory of conservation needs within the eleven western public-range states was an astute move. It will provide a basic resource inventory upon which an overall program of conservation and development can be planned. It is probably one of the most important steps in natural resource management that has ever been taken because it encompasses all lands. Arizona has completed its inventory. Oregon isn't far behind. Other state associations surely realize the beneficial impact of this basic information on future progress and are diligently developing their appraisals.

Real teamwork in the years ahead will be required if this immense range conservation job is to be accomplished. We have made much good progress in range conservation. There is still a longer road ahead. The American Society of Range Management can assist with the range conservation program, locally, state-wise and nationally and will contribute in special ways if given an opportunity.

It has been a distinct privilege for me to meet with you folks—our Nation's agricultural leaders—and to appear on your program. I can assure you it is the highlight of my term as president of The American Society of Range Management.

One of your officers—George Weaver—a Charter and Life member of The ASRM, will represent N.A.C.D. on our national program in Rapid City. Our annual conventions are held in the various regions of the range country. Next year we meet in Wichita, then in Las Vegas. Our programs provide fine opportunities for N.A.C.D. to tell ranch folks and range scientists about the soil conservation districts. We would sincerely appreciate having a representative of N.A.C.D. on our national program each year.

In closing, I would point out that the National Association of Soil and Water Conservation Districts can, if it desires to do so, play THE leading role in resolving wise multiple use man-
A Proposed Method of Determining Cattle Numbers in Range Experiments

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In range grazing studies having a prescribed degree of utilization as part of a treatment, it is necessary to estimate the number of animals to be placed on each experimental pasture. Several experiments at the Rocky Mountain Forest and Range Experiment Station have shown consistent relationships between the number of animals grazed, the amount of herbage produced, and the utilization at the end of the grazing period. This relationship can be used as a guide for stocking experimental pastures.

A general formula that has shown promise at several locations for developing a mathematical relationship is shown as formula 1 (Figure 1). In formula 1, U is the observed percent utilization of the principal forage species or class at the end of the grazing period, P is the production in pounds per acre of the principal forage species or class, and S is the stocking during the period expressed as acres per animal unit. The a, b, and c are constants derived in computation of the multiple regression.

This formula, or variations of it, has given high multiple correlation coefficients in several grazing studies in which the method was tested.

At Cebolla Mesa, in northern New Mexico, seven years of data from small seeded pastures of crested wheatgrass gave multiple correlation coefficients of 0.97, 0.98 or 0.99 for each of three study pastures, and for all pastures combined.

Cebolla Mesa is an example of the simplest use of the formula. The areas grazed were all small, contained only one principal forage species, and distribution problems were at a minimum. If the relationships existed, good ones would be expected, and were found.

In Colorado, on high-altitude summer range on Black Mesa, four years of data were collected on six experimental pastures that ranged from 110 to 394 acres. Multiple correlation coefficients of 0.97 or higher were obtained for all pastures. Here the formula was applied to the production and utilization of Idaho fescue alone, the principal forage species, although many species made up the forage. Stocking was based on the area of open grassland within the pasture. The aspen, which received light use, and the dense spruce forests did not enter into the computation.

Black Mesa was a somewhat more complicated situation than Cebolla Mesa for several reasons: the pastures were larger; a variety of species made up the forage, but only one was used in the production and utilization estimates; distribution problems were present; and not all the area in each pasture was used by the cattle. The grazing was closely controlled, however, and production and utilization were intensively sampled. Good relationships were obtained.

Data from the Jornada Experimental Range near Las Cruces, New Mexico, were used to study the possibility of such relationships being developed on larger ranges where sampling of production and utilization was on a more extensive basis. Fifteen years of data from six ranges (1,780 to 83,960 acres) gave multiple correlation coefficients exceeding 0.94, when utilization and production data for black grama alone were used in formula 1 and the acreage per animal-unit month was limited to the black grama type. Similarly good correlations were obtained when production and utilization of all grasses were combined, and the tobosa type as well as black grama type were included.

On the Santa Rita Experimental Range in Arizona, a much more complicated utilization was studied. Seven years of data were used from 16 experimental pastures that varied in area from 650 to 5,500 acres. Vegetation varied from grassland to shrub types. Grazing patterns within pastures were diverse and annual grasses, perennial grasses, forbs and shrubs provided the forage. Grazing time and methods varied by pasture. In these studies, a related formula (for-