Comments Prompted by Article on Condition Classes in August 1987 Issue of *Rangelands*

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This '87 paper is titled "Measuring Management Objectives with Condition Classes: Time For A Change." It questions the climax approach. For this approach, the only paper cited is "Condition and Management of Rangeland Based on Quantitative Ecology." It appeared in the July '49 issue *The Journal of Range Management.* The follow-up in the August '85 issue of *Rangelands* and earlier supplemental papers are not cited. Since many references to the above two titles will be necessary, they are, in this unusual case, cited simply as the '87 or the '49 paper.

The '87 paper states that most federal land management agencies use ecologically based methods of determining range condition as proposed in the '49 paper. But, this is alleged to result in confusion because "Condition assessment is not aimed at providing information about the current productivity of the resource"—a totally unacceptable conclusion.

It is granted that there is some confusion, particularly among public groups that seek to record yields from both crops and ranges. Certainly the cause is that productivity of rangeland is not measured as on cropland (vegetable matter per unit of area). On rangeland, productivity is measured by feasible stocking rate per unit of area, as derived from long-term grazing trials at range experiment stations, experience on privately owned ranches, and from analysis of grazing allotments on publicly owned rangelands. This is combined with monitoring of vitally necessary protected areas (grazing exclosures) to record changes in undisturbed vegetation and to segregate influences of climatic fluctuations from grazing influences. The non-crop approach to current productivity of grazing land was first reported from England when in 1896 productivity of various kinds of tame pasture was first reported in terms of live-weight gains by animals. Range experiment stations of the USA adopted this approach almost from their inception. Attempts to substitute clipping studies in growing vegetation while it is being grazed have not succeeded.

Discounted as a source of confusion, the conclusion that the climax approach is not aimed at productivity information is no less in direct conflict with ecological knowledge as related to *rangeland productivity.* A.W. Sampson (frequently termed "the father of range management"), after about 13 years of study in the western United States, had by 1919 concluded:

> The most rational and reliable way to detect overgrazing is to recognize the replacement of one type of plant cover by another. The grazing value of the vegetative covers is essentially determined by the stage of succession. Locally, and indeed generally, the carrying capacity and forage value are highest where the cover represents a stage in close proximity to the herbaceous climax and lowest in the type most remote from the climax.

The above quote, and research from 1926 to 1946 that served to confirm Sampson's conclusion, are included in the '49 paper. Principles outlined by Sampson in 1919 were quantified by applying continuum theory, 30 years later, in the '49 paper, when classes of range conditions were related to range sites for practical range management. In 1974, after 24 more years, the eminent ecologist R.P. McIntosh, in a review titled *Plant Ecoloy 1947*-1972, stated that the method "...having related ecological methods of gradient analysis to quantification of range degeneration, showed that potential plant cover for various physical environments could be predicted."

The '87 paper has the subtitle "Time For A Change." The Greek teacher Heraclitus, "The Weeping Philosopher," has been credited, since the 500's B.C., with the saying "Nothing is permanent except change." This is reluctantly accepted; but, changes proposed in the '87 paper are not.

The '87 paper advocates "...measures of range condition in terms of current productivity of the resource for a particular use." This was tried about 1940. At that time, on the Grand Prairie of Texas, there were both producers of Easter lambs and cow-calf operations. Winter annuals could produce much heavier Easter lambs. But, winter annuals were abundant only where the climax warm-season perennials had been "grazed out." They had prevented erosion and abnormal runoff but the winter annuals did *not* from the time of normal summer drought until their major growth in late winter and spring. The result was lowering of site potential and siltation of reservoirs and streams. This brings us to what have been called the four cardinal principles of good range management: (1) Proper kind (or class) of grazing animal, (2) Proper numbers, (3) Proper season of use, and (4) Proper distribution of grazing over the range. The first of these receives first consideration in the classic *"Range Management on the National Forests"* (1919) by Jardine and Anderson. They state: "Classification of the range to determine areas best suited to the different classes (kinds) of stock is the first important step toward best use of the grazing resources." But the '87 paper evidently would classify with respect to uses, no matter how ill suited to the site and its climax vegetation. Ranchers would, I believe, prefer a discussion of potential natural vegetation, effects on stockwater supplies and the kind of livestock or big game best suited to its utilization.

Moreover, current production for particular uses implies economic considerations which are far less stable than climate, soil, and potential natural vegetation (climax). Costs

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and incomes from various uses are too unstable to justify mapping of condition classes for various uses, though economics would certainly be a part of any discussion of plans for range and ranch management.

This '87 paper states, "Excellent condition in this (their) approach is the most productive state for a particular land use." It is commonly accepted that the three primary uses of agricultural land are for cropping, grazing, and forestry. If the '87 paper uses "land use" with this or a similar connotation, then we are carried far afield from range condition classes. The agricultural use termed "grazing" included rangeland with pastureland acreage in the 1967 National Resources Inventory (NRI) of nonfederal rural land. But in the NRI's of 1977 and 1982, they were segregated. This is progress for range science.

The '87 paper expresses concern about the introduced Lehmann lovegrass being classified as an invader where range condition classes are based on departure from climax. This confusion will continue until it is recognized that a decision on land use as between range and cultured pasture precedes classification of range condition classes. If the decision is for cultured pasture, then costs of establishment and maintenance, possibly including weed control, pesticides, fertilizers and renovation or periodic re-establishment, for maintaining the initial productivity *over the long term* must be included; not so with range use. Foresters think in terms of about 100 years, crop farmers think in terms of the next year or possibly five years for crop rotations. Ranchers, operating primarily on native perennial forage plants should, I believe, look ahead at least 11 to 22 years—thus, at least, taking into account probabilities of recurrence of severe droughts. Introduced grasses adapted for permanent tame pasture and planted on land suitable for their economical and nonhazardous maintenance can well provide a more productive use of the land than native forage; but, in that case we do not assign range condition classes.

There is a long history of mistakes in assuming that the initial productivity of introduced grasses on rangelands was a step in the right direction: first, because they did not become established except on greatly depleted native ranges with which they were compared; secondly, because after a few years the initial productivity slumped unless costly fertilizers or renovation practices were applied. It began with timothy in the 1800's. In eastern Montana crested wheatgrass seeded on abandoned fields in alternate drill rows with a mixture of native grasses compared poorly with the native when researched 17 years later. In the western Dakotas smooth brome compared poorly with native grass seedings after 10 years. In Texas, Dallis grass and King Ranch bluestem declined after several years. In the eastern half of Nebraska seeded stands of smooth brome produced far more than native prairie for a few years; but, where not fertilized they were seen being reclaimed by the native bluestems, Indiangrass, and switchgrass.

Harlan, an agronomist, in the book *Theory and Dynamics of Grassland Agriculture* had by 1956 found it necessary to devote separate chapters to "Theory of Range Management" and "Theory of Pasture Management".

The statement in the '87 paper that "More food and cover may be available for wildlife on some sites that are classified as 'poor' or 'fair' than those that are 'good' or 'excellent'" is questionable. Apart from the fact that these terms are applied to condition classes and not sites, the statement is of doubtful validity if all species of wildlife, especially native wildlife, are taken into account. (For comprehensive treatment, see book *Bioecology* by Clements and Shelford). The statement is indeed valid for *certain species* of wildlife. Prairie dogs and jack rabbits are more numerous on ranges in the Poor condition class than in the Excellent class.

Noted wildlife authority, Starker Leopold, in *Transactions of the 15th North American Wildlife Conference* (1950), referring to both mule deer and white-tailed deer, pointed out that grazing by livestock not only reduced grass competition with deer browse but also reduced fuel to carry range fires. Citing the '49 paper, he stated:

> On arid western ranges, the control of livestock grazing is the principal tool at our disposal. Excessive grazing, now so prevalent, has created many deer ranges as mentioned above but it certainly has destroyed others. Moderation in future range use is imperative to preserve the soil itself...." "Balanced use by deer and livestock is a delicate technique for controlling succession on arid lands...." "I am sure only that we must think in terms of plant successions to maintain future productivity of the deer ranges....

Also requiring comment is the statement that "An ecologically based range condition rating is at best an indirect measure of efficacy of land management programs." This carries two misleading implications: first, that they are applied to "land management programs" *in total* instead of to rangelands used for production of volunteering native forage plants on lands generally unsuitable for cultivation; secondly, that ecologically based range condition ratings are of one kind. In fact they differ among agencies, sometimes regionally within an agency.

An example of differences in "ecologically based" ratings was experienced on a mountain side west of Cody, Wyoming. A rancher had somehow managed to get rangemen from two federal agencies on the same ground on the same problem at the same time. The area had never been grazed by domestic livestock and he was considering an expensive stockwater development to make the area accessible. His questions related to: (1) the rate at which the area could be stocked and (2) what would happen to the area (meaning effects on soil and vegetation, we presumed). He asked that we work independently, and we did. One agency classified the site as " Rocky Mountain Bunchgrass Type" with range in Poor Condition. The other agency classified the site as "Very Shallow, 15-19" P.Z. Wyo." with range vegetation in Excellent Condition Class. The Poor rating had resulted from the high percentage of bare soil. But, this was easily shown to be the result of slab rock only some 6 to 10 inches below the surface. Peeling this soil off with a spade also showed that fissures in the rock were fully occupied by bluebunch wheatgrass and a few other climax species. The rancher, of course, objected to the Poor rating, saying, "It's as good as it can get now." Which it was. The vegetation was in equilibrium with the stage of soil development (edaphically climax). The difference resulted from application of Clementsian monoclimax theory, without his "preclimax" concept, by one agency while the other used edaphic or site climax (polyclimax theory). Incidentally, figuring on opposite front fenders of his jeep, we were relieved to find that we had come up with the same recommended average stocking rate (sustainable *productivity* estimate). The rancher then reflected on "What would the wildlifers and recreationists say if my range is rated in poor condition—we're pretty close to Yellowstone Park here."

The '49 paper classifies sites and places the *vegetation* in condition classes for each kind of site. The '87 paper calls for "A measure of *site* condition based primrily on soil characteristics...." The "soil characteristics" to be used in measuring site condition are not specified.

Statements about erosion in relation to ecological range condition class should be made only in relation to norms over long periods. Short-term exceptions are not hard to find. A vigorous stand of invading annual grasses on a range in the Poor range condition class can, in a good year for annuals, protect the site from abnormal erosion *if ungrazed.* A range in the Excellent condition class can show erosion if very closely grazed in a dry year with some high intensity rainfall. A Montana rancher once showed me a mountain slope range that appeared to have not been grazed that summer. I labeled it in the Excellent condition class. He then led me through a barbed wire fence onto range with the same site potential but so closely grazed that it required work on hands and knees to identify species present and to estimate their relative coverage. Some accelerated erosion was evident. Strangely, the composition was the same as on the other side of the fence. The difference was in current degree of use. When I reported to him that this side, too, was in the Excellent condition class, he permitted himself a grin, agreed, and only then told me that the fence was not old, but had been put up early that spring with driven posts and old wire.

The '87 paper confounds site condition with range condition. On "soil characteristics," as related to plant successions, and, therefore, also range sites and conditions, Hans Jenny, eminent soil scientist, in *Factors of Soil Formation* wrote:

> The recognition of the parallelism of plant successions and soil development has given new impetus to the study of the distribution of plants, and the idea of soil equilibrium has strengthened the concept of the plant climax.

Ecological research has consistently shown that the best integrator of effects of soil on productivity of natural vegetation in a given climate is the climax (the terminal stabilized system). It is a better and more easily measured expression of soil characteristics than soil characteristics alone. Many relics of climax or near climax vegetation are usually known by fieldmen, while fence-line contrasts throughout the range country show departures from potential vegetation for a site as related to history of use. Foresters have long used height of mature, native, dominant trees as an integrator of complex soil and climatic influence and term it "site index." Height at maturity or sometimes at a certain age such as 100 years has the advantage of reflecting the net effect of compensating soil differences and of ironing out the effects of wet and dry years. It is far more easily measured than the related soil characteristics, and therefore, generally more accurate.

In the regulation of runoff and erosion it is difficult to understand why the '87 paper would advocate rating site condition based primarily on soil characteristics when dealing with native range on natural grazing land. This, because on such lands proper management of vegetation permits accumulation of a natural mulch of old growth. Mulched soils permit greater infiltration. Greater infiltration promotes greater foliage production *and* plant succession. Plant communities higher in ecological succession are successively more effective in: (a) protecting the surface of the land against sealing by raindrop impact, (b) formation of larger pores through formation of soil aggregates (soil crumbs) by associated biological, chemical and physical processes, (c) producing permeability to a greater depth in the soil as a result of deeper and more complete root penetration of the soil mass, and (d) increasing infiltration opportunity because of the greater depth of surface detention and greater duration of runoff, thus providing more time for infiltration to proceed.

Where and when soil storage capacity limits infiltration, the runoff magnitude is dependent upon *the percolation* characteristics of the land. Where infiltration rate is limited by the percolation rate, the management of the vegetal cover will have a limited effect on water conservation but may still have some by: (1) increasing the rate at which water is extracted from the soil by transpiration during inter-storm periods, (2) increasing the surface mass of organic material in which storage of water takes place (as by building up a layer of organic material above the mineral soil), and (3) by rendering tight layers of soil more permeable through deeper rooting. Additional water storage on-site reduces flooding off-site. The soil can be the largest and least expensive flood-control reservoir.

Management practices can increase infiltration more than they increase transpiration when part of the infiltrated water reaches the water table; but this rarely occurs on rangelands except on deep sands or overflow sites because they are generally characterized by permanently dry subsoils.

The kind and condition of vegetal cover profoundly affects the rate of soil erosion because of two categories of effects: (a) those that modify the forces applied and (b) those that increase the resistance of the soil to a given amount of applied force. Natural vegetation of any site acts to lessen wind movement, protect from rain impact, promote infiltration, and retard the rate of overland flow. Below the surface the roots bind the soil mass.

Before a brief conclusion on the changes proposed in the '87 paper, it seems necessary to reiterate features of the climax approach that sometimes escape notice. They are: (a) that climax is not the goal of range management on livestock ranches, but, instead is the point from which condition classes are measured, with Excellent or Good condition class as the goal; (b) that in soil characteristics, the chief concern is with *edaphic* mapping units (range sites) and not soil taxonomic units; (c) that in practical range management we are concerned with secondary successions and not the long time-spans of primary successions; (d) that *rangeland* condition classification is inapplicable on forestland (generally where height of mature native dominant trees exceeds 45 ft.), and tame (cultured) pastures; (e) that changes in range condition are better measured by *relative* amounts of Decreasers, Increasers, and Invaders, than by *absolute* amounts of species present; (f) that wildlife conservation and threatened or endangered species of plants and animals are better served by the climax approach than by proposed alternatives; (g) that the '49 approach has been applied with results obvious to, and appreciated by, ranchers from the 5–9 inch Avg. Annu. Precip. Zone to the 30-34 P.Z. and up on very shallow, claypan, and coastal marsh sites; and (h) that local Technician's Guides are required, and where not already available within the Soil Conservation Service, the Bureau of Indian Affairs, the Province of Alberta, or regionally in other agencies such as the Bureau of Land Management on the watershed of the Missouri River, they must first be developed.

Taking into account regulation of runoff and erosion, along with ecological findings of Sampson and many since, it seems improbable that site condition, based primarily on soil characteristics and productivity for various uses, will displace; (1) climax as a measure of site potential on rangelands, (2) broad range condition classes as indicators of amount of improvement possible on such sites, and (3) secondary succession as the measure of progress in range improvement.

Canopy Cover as a Method of Monitoring Trend in Ecological and Soil Status

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Monitoring the trend of ecological and soil status on rangelands and grazed forests has long been considered a necessary field procedure. Historically, we have used a variety of procedures including pantograph and photograph quadrats, exclosures, fence-line photos, belt and line transects, and various randomized plot schemes and methods of measuring vegetation and soil factors. All have had good points at the time and much as been written on this subject (USDA Forest Service 1959).

Although intentions are good, the fact is that follow-through under practical field conditions is frequently neglected. Literally hundreds of plots and transects established over the years have been forgotten or abandoned. Monitoring, as a field technique, has been plagued by factors such as procedures involving too much precision for easy application by the nonresearch type people who were expected to use them; frequent transfers of personnel without continuity in the monitoring effort; and costs and workloads that led administrators to decide that other budgetary items took precedence over monitoring.

Monitoring is so important in contemporary resource management that special effort should be made to develop a simple, relatively inexpensive procedure that can meet the needs of practical resource management. Reliance on legislation to mandate monitoring is not enough to get the job done.

This article presents a simple procedure for documenting trend in ecological and soil status based on multiple factors and sensitivity to the dynamics of change, especially in early stages of trend. It is not intended as a substitute for more precise procedures where they are needed. This procedure consists of two phases, one conducted annually and one periodically over a span of years. The annual phase, already being used, consists of interpreting patterns of utilization that exist following the livestock grazing season (Anderson and Currier 1973). The periodic phase consists of interpreting data collected on permanent plots as described herein. Either of these two phases can be used alone advantageously. When used in conjunction with each other, the impact of livestock on trend is clarified in respect to the impact of weather and other herbivores, such as elk, deer, rabbits, mice and insects. Consequently, reasons for apparent trend are clearer and more realistic than if trend data, *per se*, are the only data for interpretation.

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Causes of Change

Vegetational changes over time may result from factors that are not readily apparent nor well understood. Not all changes are attributable to grazing by herbivores. Long-time observations of the synecology of ecological sites indicate that many herbaceous species are naturally cyclic in respect to their abundance from year to year and some naturally disappear for a period of years. Although weather or changes in ecological status (condition) are commonly cited as causal factors, the specifics are often speculative.

Various kinds of shoddy techniques can induce artificial vegetational changes into the data. For example, a thorough listing of species on a plot during one data collection and an incomplete listing during the subsequent collection results in the data showing changes that may not have occurred. A subsequent collection of data on a plot during a different phenological stage than existed at the time of the first collection will produce similar results.

For reasons such as these, considerable prudence is required to develop the rationale upon which a viewpoint on trend in ecological and soil status can be based; it is not a cut-and-dried procedure (R.I.S.C. 1983).

Changes Measured

Diet selectivity by herbivores causes different effects on the plant community and the resulting changes usually occur in combinations rather than as single effects (Anderson 1977). Therefore, a single criterion is not adequate for predicting trend.

In this procedure, the following changes in the plant community were selected for measurement: floristic composition, canopy cover, litter, plant vigor, and forage production. Trend in soil status is measured by changes in bare ground and cover of litter, gravel/stones and mosses/lichens.

Floristic composition is measured by listing the names of