Need of a Unified System for Measuring Range Productivity

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Range productivity is a subject of importance to all concerned with the range resource. As a most basic attribute of range its evaluation should have priority over evaluation of most other range factors. Productivity research is considered a prerequisite to study of range improvement (Upchurch 1952). Logically, the need for and results of a range improvement practice are best expressed in terms of production of the range. If assessment of range land for tax purposes is to be comparable to that on cropland, a measure of productivity is needed. Economists must have production data for analysis of the ranching industry and for proper evalution of the range resource in the economy of the nation as a whole. Public land administrators need data on forage production as a basis for allotment of grazing privileges and for harmonizing grazing with other land uses. Range conservationists must have the information for correlation of stocking rates with range sites and condition data. Much research work in the field of animal husbandry is dependent upon range production data. Last, and by no means least, the rancher needs data on production from his ranges as well as the other parts of his operating unit if he is to make sound management decisions and conduct an efficient profitable business.

Problems and Techniques

Measurement of grassland production poses many unique problems for the researcher. Watson (1950) considers accurate evaluations of pasture yields one of the most difficult techniques in agricultural experiments. Unlike other crops, grass yields are rarely measured at any one pre-determined time; the total yield may be the sum of two or more harvests or harvest may be a continuous process over a considerable period of time during which the crop continues to grow. Furthermore, the harvesting mechanism is biological rather than mechanical and the attendant variations of the grazing animal further complicate the problem.

Grassland production has received attention from many workers. Castle (1955) grouped the experimental methods for evaluating grassland production on the basis of the unit of measurement as follows:

1. Botanical composition
2. Quantity of herbage
3. Grazing days
4. Animal produce
5. Standard food units
6. Feed replacement
7. Monetary return
8. Bio-chemical analysis

Upchurch (1952) in a research committee report gave an outline for methods used in measuring productivity on range with the techniques grouped under six headings:

1. Domestic animals
2. Game animals
3. Plants
4. Hydrological characteristics
5. Cultural characteristics
6. Economic factors

The very number of techniques devised is an indication of the importance and complexity of the problem of productivity measurement. The diversity of technique is matched by diversity of units used in measurement. For example, measurements using domestic aimals have been determined in terms of body-weight gain of various age groups of either sex per unit of area, per animal, per animal unit, or per unit of time. Some data consider calf weights including cow gain or loss; others measure only the calf. Measurement of milk or wool production may or may not consider body-weight changes and may be measured per unit of time, area or animal. Some measurements have been made only in terms of numbers of animals per unit of land.

The Joint Committee on Pasture and Range Research Techniques (1952) considered the variations in technique as obstacles to maximum progress and agreed that some sort of standardization of grazing research procedure was desirable.

Present methods of measuring range productivity were sharply criticized in the report of a research methods committee on the "Economics of Range Resources Development," organized by Upchurch (1952), for the Western Agricultural Economics Research Council. The basic defect of all methods was considered as the lack of an acceptable standard unit of measurement. For example, the often-used term "animal unit month" is variously defined as: (1) a given amount of feed or forage, (2) an animal or animals grazed for one month or for an average month, or (3) a certain weight of live animals grazed for one month. Dissatisfaction was also expressed with the knowledge of relationships between range condition and trend, range forage, grazing animals, hydrological characteristics, cultural characteristics and economic factors, a lack that might be ascribed in part to diverse techniques with untranslatable terms of measurement.

Castle (1955) pointed out defects of techniques using measurement of herbage quantity, animal produce, animal grazing day, feed replacement, economic returns and bio-chemical indicators for dependable and acceptable figures on grassland production.

In spite of the lack of precise knowledge of ecological climax and

its relationships with economical factors, Stoddart (1952) believed that the most reliable method of determining stocking intensity for range was translation of range condition into stocking rate on the basis of comparison with ranges of known capabilities. It should be noted here that grazing intensity or grazing capacity is based on range condition, range productivity and economic factors with utilization generally at a very conservative level to allow for wide annual variations in production without comparable changes in stocking or damage to range flora. Comparison with ranges of known capabilities thus provides basic data for determining grazing capabilities where actual use data are not available.

Lack of a unified system of measurement has been felt in allied fields for some of these techniques have been used as a basis for other projects. Aandahl, Murray and Scholtes (1954) proposed a method for using soil maps to estimate economic productivity of land for tax assessment in which the rating for permanent pasture was based on "estimation of the relative grass production of each soil mapping unit in such terms as cow-days per acre." The "cow-days per acre" were determined in this case by estimate based on a season of use by animals, a method which makes no allowance for range condition, animal production or for supplemental feed the animals may have received. Fortunately, the authors state that their basic approach could be used with other (presumably more accurate) methods of determining grassland productivity.

Current Status

The current situation can be summarized thus:

1. Range productivity data are a basic expression of quality of the range resource prerequisite to determination of proper range management or improvement.
2. Present techniques for measuring range productivity are numerous and diverse, and generally overlook or improperly emphasize one or more factors.
3. There is no generally accepted standard unit of measurement of range productivity; the data gathered on any one research project are usually applicable to all portions of that project but can rarely be applied or translated to apply to other research data.
4. Research work in allied fields such as range improvement, range economics, and animal husbandry lacks acceptable range production data to use as a base for further study.

To state the basic considerations in developing a unified system of measuring range productivity as: (1) accuracy, (2) economy, (3) versatility, and (4) simplicity, would be over-simplification, although any system devised must pass the test of these criteria.

Of primary importance is recognition of the differences between range and tame pasture and proper consideration of the significant factors. Range, as land that produces primarily native forage suitable for grazing by livestock (SCSA 1952), differs from tame pasture in that the vegetation is usually a wide variety of native species, and maintenance of a permanent cover is generally imperative. Soils in range are as important as in tame pasture but this factor is generally recognized in conjunction with climate and topography to delineate range sites (SCSA 1952). In tame pastures, the soils should be evaluated in terms of their ability to produce various cultivated forage crops. Climax vegetation is generally considered the potential type of cover for a range site and range condition is measured by departure from that potential. A general but direct relationship is known to exist between range condition and productivity (Dyksterhuis 1949). Consideration of range condition, based on plant succession and climax, appears to be essential in measurement of relative as well as absolute range productivity. Fully sustained production of the composite resource of soil, climate and native vegetation cannot be predicted unless site and range condition are taken into account. It must be re-emphasized that overgrazing of range will give high initial yields with degeneration of the vegetation and subsequent decreased production. While such overutilization gives an overstatement of productivity, underutilization may give an understatement of productivity (Anon. 1952). Utilization standards thus also become a vital part of productivity measurements on range.

It is generally accepted that measurement of range production must be related to grazing animals despite the difficulties of accounting for differences in animals such as grazing preference, daily intake and conversion of forage to gain. Grazing trials, however, are not economically feasible on each ranch. In addition, any results from measurement must be translated into terms usable for management predictions and decisions. Grazing capabilities are generally determined today by inventory of cover conditions, and in some agencies also soil conditions, correlated with use histories on comparable ranges. All systems are seriously limited by the lack of grazing history for many ranges (Sampson 1955). Quantitative measurements of forage yields correlated with grazing trials would be valuable in checking and augmenting field estimates and grazing history records and may some day serve as a basis for establishing standard coefficients. This assumption, however, is predicated on use of a dependable unified system of quantitative measurements of range flora and herbage samples.

The selection of standard technics and a unit of measurements is evidently the basic consideration in developing a unified system. The number of variations in use today is sufficient evidence for this assertion. Any unit of measurement adopted must be translatable into

a form that can be used by each group concerned; animal husbandmen and economists, for example, need this data as much as the ranchers and range men. The unit should be capable of expression in terms of effect upon animals from the grazing and digestion of the forage. Castle (1955) and others (Anon. 1952) believe that the unit of pounds of total digestible nutrients, commonly referred to as T.D.N., offers the best available means of meeting these criteria. Some difficulty may be experienced in using this term due to inadequate coefficients of digestibility and nutrient requirements. Biochemical measurement techniques using digestible or indigestible tracer elements or combinations of the two give promise of providing this information on plant values for grazing animals. Raymond (1954) and his associates (Raymond, *et al.* 1954) considered these techniques critically and proposed the faecal index measurement as the most suitable.

Summary

With this brief review of biological, physical and economic problems involved in developing a unified system, we may perhaps conclude that a unified system of measuring range productivity must contain provisions for appraisal of these factors:

1. Range site and condition class.
2. Degree of utilization of the herbage in relation to range condition and trend.
3. A standard unit of forage measurement clearly defined and readily translated.
4. Supplemental data required to approximate equivalents in related sciences.

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During his editorship, the Journal has gained in stature and prestige. It is highly sought after by libraries from all over the world. He has kept the articles factual and yet presented them in an interesting and readable style. We have received compliments on the Journal from ranchers and technical people alike.

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Thanks, Bob, for a job well done. We are all proud to have known and worked with you.

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