RANGE CONDITION : VEGETATION CHANGE OR PRODUCTION

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It is readily understood that when natural grasslands and shrublands are grazed there will be some changes in the plant community. The more permanent changes, arising from the loss of some plant species, the invasion of others or a general thinning out of the vegetation, are referred to as changes in Range Condition. Our interest in these changes is not based on the change itself, as the preservation of plant species is not our primary concern. The occupation of land for agriculture is usually accompanied by profound changes in the vegetation, without the connotation of this land being in poor condition. Rather our interest arises from the decline in long-term productivity that may accompany such changes. Two significant examples of this may be noted in Australia - the semi-arid woodlands of N.S.W. and the Pilbara of W.A.

Over the last decade Australian rangeland scientists have attempted to establish systems for recording these changes, with the hope that such measurements will identify problem areas and properties, before they reach a serious stage of decline. In this article I wish to comment on some of the developments in our concepts of what is range condition and how it should be measured.

USA SYSTEMS INADEQUATE

Range scientists in USA have been active in this field for about 50 years. Although many systems have been tried, they now emphasize the Quantitative Climax System (Dyksterhuis 1949) which is based entirely on measuring the changes in percentage botanical composition.

From the beginning attempts have been made to apply this system in Australia (Lendon and Lamacraft 1976; Perry 1976) although other systems have also been proposed (Payne _et al_. 1974; Christie 1978). This so-called "Dyksterhuis" system has been advocated, principally because it is "ecologically-based" and therefore thought to be superior to other methods based on productivity (Perry 1976; Hacker 1979).

However, many functional problems have arisen with the Dyksterhuis system as attempts have been made to apply it to the Australian rangelands. An initial list of problems may be attributed to Smith (1979); an American working in arid rangelands. A longer list of problems is as follows -

a) The method assumes that original or near-original is 'best'.

b) In extensively altered vegetation, no examples of 'original' vegetation remain.

c) It assumes a stable plant composition in the absence of grazing. Fire and drought effects are ignored.

d) Lay people assume a direct relationship between vegetation change and animal productivity (the item of interest), but this is often not so.

e) The method cannot cope with useful introduced plants.

f) It only records changes in plant composition and ignores declines in plant quantity - an important indicator of loss of production and increased erosion.

g) The degree of vegetation change is not constant - it depends on how it is measured.

Each of these problems can be overcome by appropriate adjustments, but the evaluation of these adjustments is invariably made on the basis of animal production, although rarely stated as such. The South Africans have also noted these problems, and the adjustments outlined by Foran et al. (1978) are of this nature.

ATTRIBUTES OF CONDITION

The problems outlined above arise from an inadequate analysis of the factors that we include in our general perception of changes in range condition. Primarily, the changes noted are in the vegetation, but this includes both composition (which plants are present) and quantity (total amount present). Changes in composition must also include changes in the balance between herbage and shrubs or trees. Secondarily there may be changes in the soil, such as its ability to hold moisture, its fertility, or its rate of erosion, all of which will tend to make the vegetation changes permanent. Finally, there may be changes in productivity, mainly in the number of animals carried, but perhaps also in their weight gain, or in other factors of interest, such as water yield or value as wildlife habitat.

With these many factors, each varying in importance according to vegetation type and land use, the idea of a single and universal measure of condition becomes unattainable. At best, there will be situations where two factors are correlated. The solution to these problems is to abandon attempts to measure range condition as a whole and instead to separately measure each attribute of interest. In particular measures should be constructed of change in animal carrying capacity. These will continue to be based on vegetation measurements, but will be compiled into production indices on the basis of knowledge of the growth, palatability and nutritive value of the species.

VEGETATION CHANGE AND ANIMAL PRODUCTION

Some changes in botanical composition are clearly deleterious. However, the importance of other vegetation changes is not so clear. For instance the loss of the dominant edible shrub Atriplex vesicaria and its replacement by Danthonia caespitosa has been found to either increase or not change the number of sheep that can be carried (Wilson and Leigh 1970). This research relates to the southern part of the Riverine Plain and at first was thought to be atypical. However, R.D. Graetz (personal communication) has recently recorded a similar result in the Barrier Range, where the shrub is replaced by edible Sclerolaena spp. A possible general conclusion is that large changes in botanical composition will not affect carrying capacity, unless the replacement plants are inedible, of low productivity or there is no replacement plant at all.

Neither is it sufficient to assume that perennials are superior to annuals. For instance A. vesicaria is truly perennial, while Sclerolaena spp. are described as biennials. Communities that are dominated by such shorter-lived plants may have high rates of animal production, and ephemerals also have a significant place in animal production (see Leigh et al. 1979).

The conclusion is that vegetation change is not necessarily deleterious and plant species should be classified on a desirable-undesirable scale, rather than on a decreaser-increaser scale. Further, quantity is as important as composition and this information should not be lost by expressing results in terms of percentage composition.

An example of the difference between vegetation change and change in potential productivity is shown in Table 1. In this instance a major change from the edible shrub Atriplex vesicaria to copper burr and perennial grasses is not deleterious to animal productivity. Thus it is of little value to express condition in terms of vegetation change, even though that change is clearly visible. The vegetation is different, but not inferior.

Table 1. Foliar cover of principal species on two Barrier Range plots, across a fenceline of vegetation change (Spring 1978)

Species	Reference cover	'Overgrazed' area
Desirable species		
Atriplex vesicaria	7.1	0.0
Perennial grasses	4.2	9.1
Copper burr (*Sclerolaena* spp.)	5.5	7.4
Bluebushes (*Maireana* spp.)	0.8	0.2
Undesirable species		
Atriplex spp.	5.4	2.4
Poverty bushes (*Sclerolaena* spp.)	2.3	1.9
Total	25.3	21.0

Relative cover of desirable species		95%
Indices of species change:	percentage similarity	54%
	: quantitative climax	60

CONCLUSIONS

It should be emphasized that this paper does not advocate that range condition be equated to animal productivity. Rather that range condition is a general concept about change in land value, of which animal productivity is our most important current interest. At the measurement level we can determine particular attributes of condition, such as plant composition, degree of erosion or potential animal production, but there is no rational way of adding these together to give an overall index of condition. Nevertheless, in our minds, condition becomes equated with the most important of these attributes in the particular land type in which we work.

It has been said that range condition should be measured in terms of vegetation change and then other attributes can be related to this (see Perry 1976, Figure 2). The proponents of such a system may not realize that vegetation change is not an absolute entity. For any given site, the index of change will vary widely according to the method chosen to measure the vegetation (e.g. biomass, cover, density), the species included (annuals and unresponsive species are sometimes excluded), the data transformation used (e.g. percentage) and the similarity index used to measure the departure from a reference site. Hacker (1979) prescribed eight such indices, all of them ecological, and his data show the wide range in recorded condition that may be obtained on one site. Even the choice of biomass as a measure is a decision to emphasize the productive attributes of a vegetation.

So, we can measure vegetation change by one means or another, but the index chosen will reflect judgements that have been made according to our purpose in measuring that change. If botanical composition, as measured by the Quantitative Climax system serves that purpose (e.g. because the major change in our vegetation is from an edible to an inedible plant) then that method can be used. However, this does not make this sytem a universal measure of condition, or more ecologically-based than any other method. The Quantitative Climax method is not wrong, but it is incomplete.

In terms of these comments, it is suggested that the method used for measuring range condition in central Australia which is based on percentage composition (Lendon and Lamacraft 1976) is incomplete. It needs the addition of a quantity factor (e.g. Foran et al.), or more simply the expression of vegetation data in terms of absolute rather than percentage amounts.

It is also concluded that the separation of ecological and productivity-based methods is artificial. Ecologically-based methods will be constructed and interpreted in terms of productivity, while productivity-based methods will depend on the methods and concepts of ecology for their measurement.

A more formal presentation of these ideas has been accepted for publication (Wilson and Tupper 1982).

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