A PRELIMINARY REPORT ON A MODEL FOR RANGE AND BIG GAME MANAGEMENT

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A model may be defined as a representation of a real system which approximates the real system to a greater or lesser degree. Once the model is constructed, predictions can be derived from it by feeding in sample values. The accuracy of the predictions is dependent upon the degree to which the model approximates the real system.

The model described here is intended to give insight into the problem of regulating big game animals in relation to available forage resources. It was originally constructed from data obtained from the Goodale range bitterbrush (Purshia) stand on the east slope of the Sierra in Owens Valley. The study involved a problem of competition between deer (Odocoileus hemionus inyoensis) and tule elk (Cervus nannodes). The specific data from this study will be foregone here in favor of a generalized description of the model as it might apply to many big game ranges.

REQUIREMENTS AND METHODS

A game range must possess a common and widespread perennial plant which can be designated a "key species" before this model can be employed successfully. A key species is one which, by the nature of its palatability, shows damage from grazing before the remainder of forage plants on the range. Thus correct management of the key species will automatically preclude damage to the lesser forage species. The area occupied by the key species must be determined.

Within this area, a minimum of five transects should be established. They should be placed so that they extend over the full range of grazing pressure, from the heaviest used areas to the lightest. Obviously, on large heterogeneous ranges, more transects will be required. However, mean utilization calculated from the transects should approximate the average use for the total area.

On each transect, measurement of the per cent utilization of the key species should be made and pellet groups counted. The transect must be large enough so that the samples of both pellet groups and forage utilization on a single transect are based on an adequate sample. In the present study, 1/13th acre transects measuring 660 feet by 5 feet (Wood, et al., 1960) proved satisfactory. Utilization was measured on 20 permanently marked plants along the length of the transect. Pellet group counts are made on the same transect. On seasonal ranges, as for example a deer winter range, pellet groups for the current season can be distinguished from older pellets. On year-long ranges, the pellet groups would have to be cleared at the beginning of the study each year. Much of the failure in accuracy of the pellet count technique is traceable to inadequate sampling and human error (Julander, et al., 1962; Van Etten and Bennett, 1965). Since the reliability of the model is dependent upon accurate pellet counts, careful work and an adequate sample are necessary.

CONSTRUCTION OF THE MODEL

The construction of the model will be demonstrated with a hypothetical example. Assume that we are interested in a 1000 acre deer winter range, which the herd occupies for 120 days (4 months) in the winter. We have established 10 transects, 660 feet by 5 feet, and we read them immediately following the grazing season. The data are listed in Table 1.

The first information we can derive from these data is an estimate of the deer population based upon the pellet counts. The mean number of deer pellet groups per transect, 26.1, is also the mean number of deer days per acre because the transect is 1/13th acre and deer defecate approximately 13 times a day (Smith, 1964, and many others). Since we also know the area involved and the time the herd was on the range, we can derive a population estimate by the following formula:

$$\frac{\text{deer days per acre X acres}}{\text{days on range}} = \text{number of deer}$$

or

$$\frac{26.1 \text{ X } 1000}{120} = 218 \text{ deer}$$

We now turn to the key species utilization figures and establish the relationship between forage use and grazing intensity as indicated by pellet counts. This relationship is plotted in Figure 1. The linear relationship shown has been found to hold true for the ranges studied in Owens Valley. What the straight line relationship implies is that the key species is taken in the same proportion relative to the other forage species present on the range irrespective of grazing intensity.

Thus the regression line in Figure 1 is valid only for the forage situation during the period from which it was derived. If a substantial alteration of the forage composition or availability occurs, a new curve must be derived. Possible cause of such alterations might be fire, range habitation, abusive grazing, etc. Also, the advent of new green growth in the spring alters the food situation, and the period of range use should be terminated at that time. This is the time when normally the grazing pressure on the permanent vegetation is terminated. Another consideration is the variation of forage availability depending upon the amount of rainfall in semi-arid and arid regions. In good years there is high production, while it is low in drought years. Utilization will vary with the amount of production of the key species. Thus, over a series of years, a family of regression lines will be obtained. The manager must select the regression line which is most typical for the range conditions of his area.

Assuming that the regression line in Figure 1 was derived during a typical year we are ready to proceed with the model. The next consideration is the proper use factor for the key species, i.e. the per cent utilization of the plant which still allows it to carry on its own physiological processes successfully from year to year. For example, Hormay (1943) considered 60 per cent to be the maximum allowable use on bitterbrush compatible with the continuance of the stand.

Suppose the allowable use is 60 per cent for the key species of the model considered here. Going to Figure 1, we can locate 60 per cent utilization and read over to the regression line and down to find that 40 deer days per acre (pellet groups per transect) would be expected to result in this amount of utilization. We can then convert deer days per acre to number of deer.

Performing the calculation we obtain a value of 333 deer. Since our population was estimated at 218 deer, we are under-utilizing the range resources, which would winter an additional 115 deer. No harvest should be made. Assuming that 40 per cent was the proper use factor, our model would indicate that 225 deer could be supported. Thus the present population of 218 deer is virtually at the carrying capacity of the range. If, however, 20 per cent was the use factor, only 108 could be wintered. A harvest of 110 deer would be required to bring the population down to a safe level.

DISCUSSION

The main advantage of this model over the present method is its predictive ability. By feeding in values appropriate to the particular range, estimates of carrying capacity can be obrained. These estimates are based upon forage utilization, one of the most precise measures of impact of grazing upon a range.

Another major advantage of this model is its flexibility, which allows it to be employed in any area where a key species can be designated and where suitable utilization and animal use census techniques are avail-

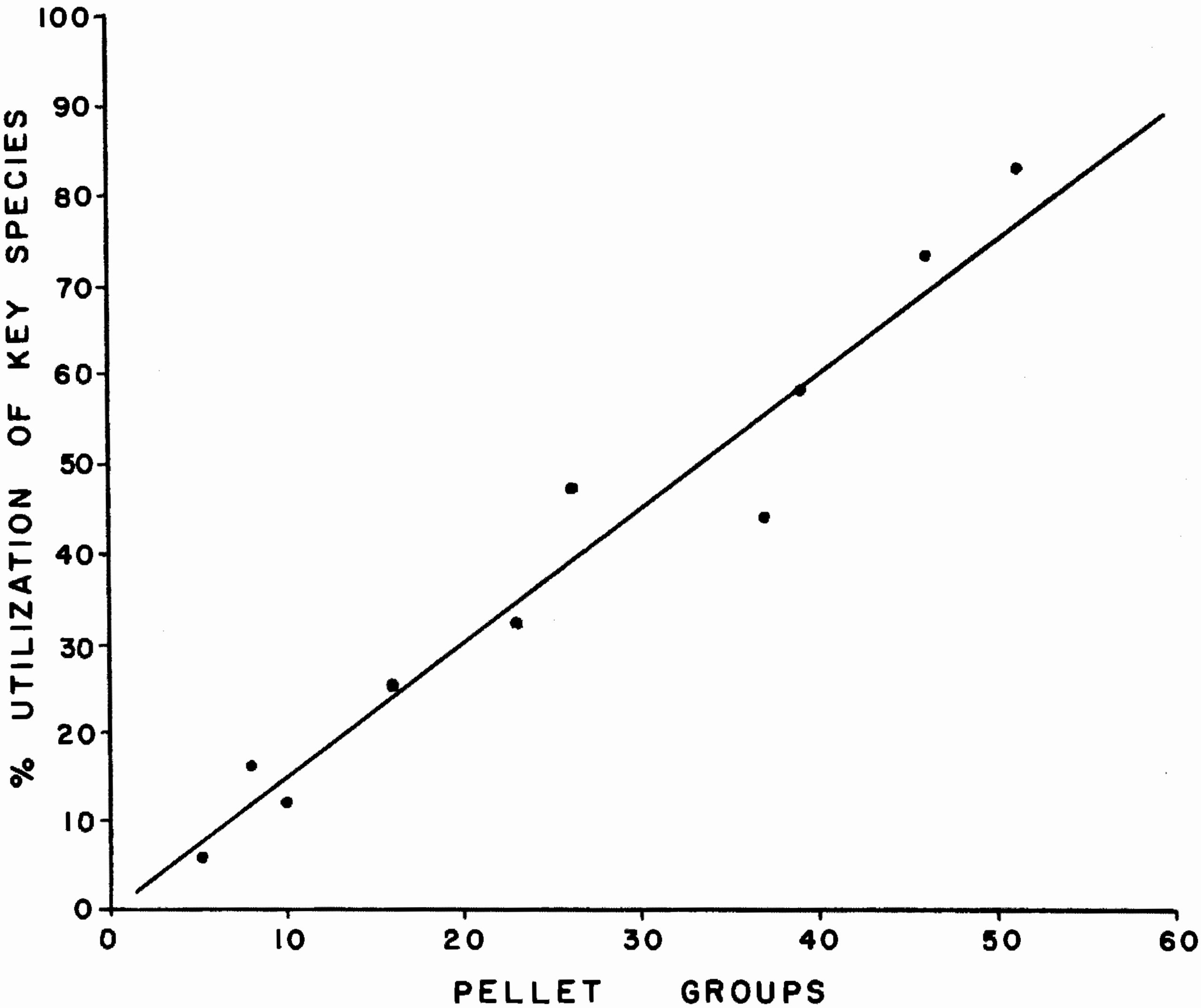

Figure 1. Relationship between key species utilization and grazing pressure based on pellet group counts, plotted from the hypothetical data in Table 1.

able. The appropriate regression line can be established which best reflects the long-term range situation. Or, if adequate regulatory power is obtained, the regression lines for the conditions of each year can be used. In good years the population can be allowed to build up, provided an adequate harvest can be made in the poor years to bring the population down to the very much lower carrying capacity. The proper use factor can be set for the key species used. If time shows that this use factor is too high or too low, it can be corrected by feeding an adjusted use factor into the model. Similarly, if the placement of the transects turns out to be incorrect, and the mean utilization from the transects does not approximate the utilization of the total range, this error can be adjusted by changing the use factor rather than relocating the transects.

A third advantage of this model is its simplicity. The necessary data can be obtained using well-established techniques presently available. In terms of effort, it requires little more time than is already spent in reading transects in situations where a statistically valid sampling program is in effect. On the other hand, increased efforts will greatly increase the usefulness and precision of the model.

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Table 1. A hypothetical set of data used to illustrate the model. It is assumed that the area is 1000 acres and that deer use the area for 120 days in the winter.

Transect Number	Pellet Count	Per cent Utilization Of Key Species
1	46	73
2	23	32
3	39	58
4	26	47
5	5	6
6	8	16
7	37	44
8	16	25
9	10	12
10	51	83
Mean =	26.1	39.6