In most vegetation studies a plot technique is used for sampling. In many studies it is required that each plot must be large enough to contain the 'characteristic structure and floristics' of the phytocoenose. The determination of plot size has occupied the attention of many plant ecologists; the general conclusion being that 'an objective method of plot size determination seems impossible' (Werger, 1972). Werger (1972) and Moravec (1973) have reviewed these studies.

In this paper a regression equation relating optimal plot size (Werger, 1972) to easily measured vegetation characteristics is constructed. If this regression equation could be improved and tested more widely it could form the basis of a rule-of thumb method to estimate optimal plot size in the field.

The methods of Werger (1972) were used to determine the optimal plot size of 32 phytocoenoses. Werger's definition of optimal plot size is that size which contains a specified percentage of the number of species calculated to occur in one hectare. Therefore if there are 80 species in one hectare (100% information), and if 50% information is required, then optimal plot size is that area which contains 40 species. Werger (1973) used 50 – 55% information in his phytosociological studies in South Africa. The regression equation

$$y = a + b \log_e x$$

(Gleason, 1925; Goodall, 1952) was used in the present study and by Werger (1972), to calculate the number of species in one hectare of the sampled vegetation (y is the number of species in area x, and a and b are constants that are calculated with each set of x, y values from every phytocoenose). The data to calculate optimal plot size came from nested circular plots of sizes varying between 0,8 m^2 and 1256 m^2 in 12 of the 32 phytocoenoses, and from nested rectangular plots of sizes varying between 1 m^2 and 256 m^2 in the remaining phytocoenoses.

For each of the 32 phytocoenoses the following vegetation characteristics were recorded:
(1) H = maximum height (m) of the tallest stratum.
(2) T = total projected cover (recorded in 10 classes 1 = 1–10% cover, 2 = 11–20% cover, ...and so on 10 = 91–100% cover).
(3) C = projected cover of the tallest stratum (recorded as for T).
(4) Number of species in 200 m^2 (usually determined by extrapolation of the species-area regression equation).
(5) Number of strata (for this particular vegetation characteristic a stratum had to have more than 25% cover to qualify as a stratum).
(6) % species in the tallest stratum.

The phytocoenoses that have been used cover a range of vegetation types in South Africa, chiefly the semi-desert vegetation of the Karoo (n = 10) and the fynbos of the Cape winter-rainfall region (n = 17). Also represented are grassland (n = 2), and woodland and forest (n = 3). Fifteen of the phytocoenoses used are from Werger (1972).

Vegetation structure has long been know to affect plot size (refer to Werger, 1972, for further discussion). Therefore it is not surprising that height of the tallest stratum (H), total cover (T), and cover of the tallest stratum (C), are all significant ($p < 0{,}005$) in the regression equation relating optimal plot size to vegetation characteristics.

Vegetation height is usually positively correlated with average crown diameter. The larger the diameter, the larger is the average interplant spacing; therefore height of vegetation is positively correlated with optimal plot size.

Because of the greater interplant spacing in vegetation with low total cover, or in vegetation in which the tallest strata have low cover, optimal plot size is negatively correlated with these vegetation characteristics.

Of the various possible regressions relating optimal plot size to vegetation characteristics, the most successful were the following (various transformations of the original variables were attempted but proved less successful):

For 40% information per plot (r^2 = 0,51):
$P = 32{,}4 + (2{,}0)(H) - (1{,}5)(T) - (1{,}5)(C)$
For 50% information per plot (r^2 = 0,50):
$P = 80{,}7 + (4{,}6)(H) - (3{,}3)(T) - (3{,}5)(C)$
For 55% information per plot (r^2 = 0,48):
$P = 127{,}4 + (6{,}8)(H) - (4{,}8)(T) - (5{,}3)(C)$
For 60% information per plot (r^2 = 0,46):
$P = 199{,}8 + (10{,}0)(H) - (6{,}6)(T) - (8{,}1)(C)$

where P is the optimal plot size (m^2) and H, T and C are as given above.

The r^2 values indicate that only half of the variation in the calculated values of optimal plot size is accounted for by the three vegetation characteristics in the regressions. The r^2 values could probably be improved if more sophisticated vegetation characteristics could be used (e.g. direct measures of crown diameter, crown overlap, and cover by vegetation strata). Much of the variation in optimal plot size which is not accounted for may be due to the errors that arose when determining the vegetation characteristics of the 15 phytocoenoses reported by Werger (1972). We had to glean our information for these phytocoenoses from Werger (1972) and Werger (1973); we were unable to do any field recordings for his work. We would also suspect an improvement in the r^2 values if more than one species-area curve had been constructed in each phytocoenose.

It is difficult to explain the lack of correlation between optimal plot size and floristic richness (here measured as number of species in 200 m^2 – $P > 0{,}4$). One would have suspected a positive correlation (Werger, 1972).

Choice of plot size is often dictated by success or failure of previously used plot sizes. Therefore, for example, in regions with a long history of phytosociological research plot sizes that are suitable are listed by vegetation type (e.g. Mueller-Dombois & Ellenberg, 1974: p. 48). In the numerous regions where phytosociological studies are yet to begin, a regression equation that relates optimal plot size to vegetation characteristics could be of use. Therefore if the regressions of the type reported in this paper could be improved, as we feel they could, a phytosociologist could calculate optimal plot size by determining a few, easily measured vegetation characteristics.

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