An enhanced wheel-point method for assessing cover, structure and heterogeneity in plant communities

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Abstract

A wheel-point apparatus and hand-held computer are operated by one person for logging, checking, and summarizing of plant data. The point cover method is modified to record plant community composition by cover and vertical structure and to derive an index of spatial heterogeneity of composition along a transect using the wheel-point in combination with the computer.

Key Words: hand-held computer, cover, structure, heterogeneity

Aerial cover of plant species is commonly estimated to describe vegetation (Goodall 1952, Sykes et al. 1983). Numerous techniques for quantifying cover have been developed, including a frame-point quadrat (Goodall 1952), point-intercept using points along a tape measure or line, point-intercept using a cross-hair sighting tube (Winkworth et al. 1962), step-point using a mark on an assessor's footwear (Evans and Love 1957), and a wheel-point apparatus (Tidmarsh and Havenga 1955, von Broembsen 1965). The wheel-point was developed primarily for assessing aerial cover of the herbaceous layer in vegetation with a sparse shrub and tree cover and is now the most widely used of the point cover techniques (eg., Mentis 1981, Holm et al. 1984, Friedel and Shaw 1987). A wheel-point apparatus is a rimless wheel that rolls over the ground on its spokes. The position where a spoke (point) touches the ground or a plant vertically above a point on the ground is considered an intercept point for data recording. Aerial cover is the sum of strikes on plant species as a percentage of the total number of points sampled on a transect.

The frequent choice of the wheel-point over other sampling devices is because of a combination of preferred attributes. It provides an acceptable level of accuracy and repeatability, particularly if a single observer is used (Walker 1970, Sykes et al. 1983). It enables rapid assessment over a large area and is relatively uncomplicated in its operation. Its drawback is in recognising what constitutes a strike of the point on a plant. This is overcome by using the consistency of a single observer, but implies that sampled sites can only be compared relatively.

The acquisition of data with a wheel-point apparatus usually requires 2 people. Walker (1970) suggested that 3 are needed: one to operate the wheel-point, one to observe the strikes, and another to record by writing on to data sheets. Such data are usually transposed at some later time into a computer or are otherwise rewritten for analysis. Original errors in the field and transferring errors often prove difficult to correct because of the time between field recording and office checking. When only summary cover data are recorded, it would usually not be possible to identify errors after field recording.

Cover data are usually registered as cumulative sums against each species or category. Data of this type are used to describe a site on the assumption that any heterogeneity in the distribution of plants will be included within the summed values for a sampled site. Detection of patchiness and the description of structure in vegetation has not been previously attempted using point cover data. In most plant communities, individual plants are rarely distributed randomly at any scale, particularly in the arid zone (Anderson 1970, Lamacraft et al. 1983).

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Fig. 1. *Field operation of the combined wheel-point and computer. The wheel-point is attached via a frame to the backpack and is pushed by the body of the operator. The computer is held in a box by a strap around the operator's neck. The computer displays and prints in the field.*

The volume of data collected for surveys, ecological studies, environmental impact studies, and land monitoring purposes has grown rapidly in recent years. This in turn has resulted in the need for rapid and accurate data collection techniques and means of rapidly analyzing the data in the field or immediately after field work has been completed. Light-weight, portable computers have yet to be extensively incorporated into field recording of vegetation data. Such devices can operate relatively large and complex programs designed for specific or general purpose data collection and with a large number of in-built checking routines. The real advance for field work is that precise definition of the data structures and collection procedures are required. This enables almost all data checks to be performed on site. Large complex data sets can be efficiently collected, checked, stored, analyzed, and subsequently transferred to other computers.

This paper describes a technique for combining the wheel-point

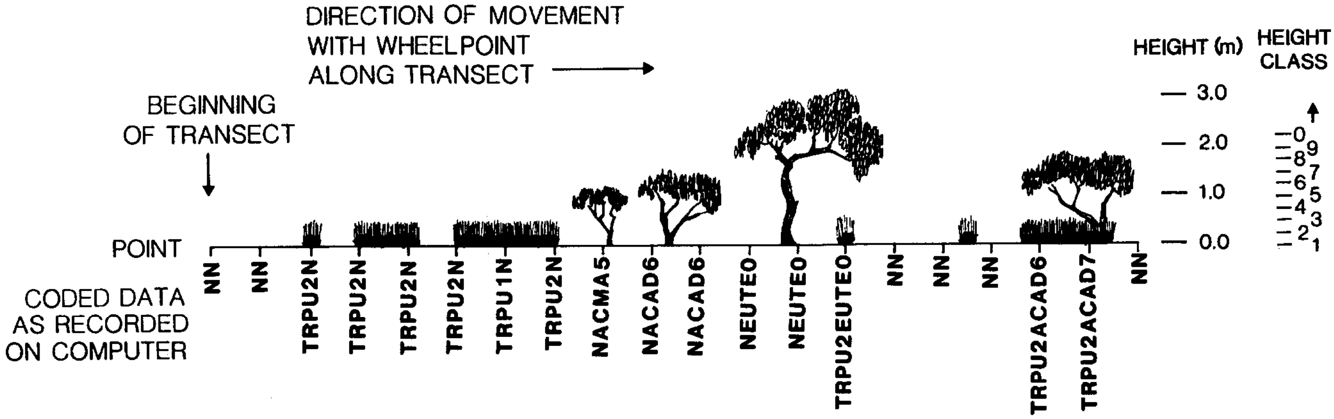

Fig. 2. *A sample wheel-point transect of 20 points to illustrate the type of data collected as an operator moves from left to right. In the coded data TRPU=* Triodia pungens, *ACMA* = Acacia maitlandii, *EUTE* = Eucalyptus terminalis, *ACAD* = Acacia adsurgens, *NN = no plant in the herb or shrub layer, the numeric values represent the height classes of the plants in each statum.*

apparatus with a hand-held computer so that one person can both collect and check cover data in the field. In addition, information about plant vertical structure is also recorded. The sequentially recorded data can be analyzed for an index of compositional and structural heterogeneity across the site. The enhanced wheel-point method is most appropriate in sparsely vegetated areas where plants are usually separate from one another and 2 or more plants rarely occur over the same point.

Materials and Methods

Equipment

A wheel-point apparatus is attached to the frame of a backpack so that the apparatus can be pushed by the body and maneuvered comfortably through thick vegetation without the use of the operator's hands. The portable computer is held in a small box supported by a strap around the operator's neck (Fig. 1). In this way the operator has both hands free to operate the computer and when necessary, give additional guidance to the wheel-point.

Data are thoroughly checked by software for structural and spelling inconsistencies then stored directly into the RAM memory of a Sharp PC1500 portable computer (several other computers are similarly small, portable, and have equivalent memory). At regular intervals (each 100 points) the data are stored onto a portable cassette tape. After field sampling, the data on tape are transferred to a larger computer for more complex analysis, if required. The software has been field proven with sampling of over 100 transects, each transect being sampled for 1,000 points of data. The only limitation to data collection is that each block of 100 points be collected before being written to cassette tape. The number of 100 point blocks written to tapes is unlimited.

A program listing and detailed operating instructions are available on request from the author. A program to read the data from tapes and transfer them to another computer is also available from the author. Further programs for microcomputer analysis of the data are available.

Sampling Procedure

Transects can be sampled with any number of points in multiples of 100, each point a fixed distance apart. Data are collected from the herbage and, tree and shrub layers. At each point, potentially 4 items of information (2 in each layer) are recorded. First, if a herbage species is struck with a point, a 4-letter code representing that species is recorded (for example TRPU for *Triodia pungens).* At the point of strike, the height of the plant above the point struck is recorded in 1 of 10 height classes, for example in .25-m intervals (ranging from 0 to .25 m up to >2.00 to 2.25 m and a class for all plants >2.25 m). The same information is gathered for plants in the tree and shrub layer above the point; a strike is defined as contact with the canopy on a line rising vertically from the point. Data from both strata are concatenated and stored in the computer memory as a single word. Only 2 layers in the data are recorded since the incidence of more than 2 species over the same point is extremely low in sparse vegetation. This method differs from conventional aerial cover estimates in that it is possible to have more than 100% cover when 2 species are recorded frequently over each point, although this has not occurred in any field experience. A fabricated example of a short transect and the data gathered from it is illustrated in Figure 2.

A measure of spatial heterogeneity is derived from the data by segmenting the entire transect into several equal 'lengths' and calculating the cover of all species within each 'length.' The cover values for species can then be compared between all 'lengths' and a measure of heterogeneity derived by using the algorithm of Rotenberry and Wiens (1980) which calculates the normalized sum of the differences between the maximum and minimum cover values in all 'lengths' for each species. As an example, 1,000 point transects are treated by the author in 'lengths' of 200 points. The number of points included in a 'length' will be a function of the total cover and of the scale of patchiness to be detected. The 'length' can be altered in software that analyzes the data.

Discussion

A wheel-point strapped to the operator and a hand-held computer proved to be both comfortable and easy to use. The maneuverability of the wheel-point was not reduced, provided the method of attachment to the operator was not too rigid. In several vegetation types, ranging from dense shrubland to open hummock grassland an experienced operator can sample a 1,000 point (points 1 m apart) transect in 1 to 3 hours depending on the cover and structural complexity of the vegetation.

Temperature limitations (up to 40° C) or dust in the computer were not serious problems even in the conditions experienced in central Australia. The small keys on the computer did not inhibit data entry, particularly if function keys were used. The complement of function keys store the full codes of the most frequently encountered species and can be entered with a single keystroke.

There are no *a priori* reasons for assuming an inter-point distance for sampling, especially in relation to the dimensions of individual plants. However, a method for estimating the appropriate distance between points for cover measures has been devised by Davy and Jakeman (1984).

Compositional and structural analysis can all be performed in the field on the data collected with the enhanced wheel-point and computer method. Griffin (1984) successfully used an early version of the method to measure and analyze pattern and post-fire successional trends in spinifex dune-field vegetation at Uluru National Park, Northern Territory, Australia.

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