Additional reading

Short communications

A simple, inexpensive method for estimating linear tree dimensions

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A simple, inexpensive method for estimating linear tree dimensions is described and tested. The method is based on a visual overlap of two images, namely, the tree to be estimated and a group of length scales incorporated on a colour slide. Additional advantages of the proposed method include accuracy, application by one person only and both vertical and horizontal estimating capabilities.

'n Eenvoudige, goedkoop metode vir die skatting van lineêre boomdimensies word beskryf en getoets. Die metode berus op 'n visuele oorvleueling van twee beelde, nl. die boom wat geskat moet word, en 'n stel lengteskale geïnkorporeer op 'n kleurskyfie. Addisionele voordele van die voorgestelde metode is akkuraatheid, aanwending deur slegs een persoon en beide vertikale en horisontale skattingsmoontlikhede.

The determination of tree height, canopy diameter and other dimension measurements of trees is often necessary for research and other surveying purposes.

Reliable dimension estimates of trees can be made without the use of time-consuming apparatus, such as the tape-measure, and costly and sometimes difficult to obtain apparatus, such as the telescopic ranging rod (Panagos, pers. comm., M.D. Panagos, Botanical Research Institute, Private Bag X01, Pretoria 0001), as well as the Blume-Leiss and Meridian meters (Nel, 1965). A quick one-man method has been employed successfully to obtain accurate estimates of tree dimensions.

The proposed method is based on a visual overlap of two images, namely, the tree to be estimated and a group of length scales (Figure 1). The length scales are incorporated on a 35-mm slide with a white background. The same principle was first used by Westfall & Panagos (1984) for canopy cover estimations. To produce such a slide, the lines in Figure 1 can be duplicated to scale on a piece of white paper and then photographed on slide film.

The slide with length scales is placed in a simple, inexpensive slide viewer consisting of a lense at the one end, and an opal screen at the other. These slide viewers are available at most photographic dealers. In practice one should look through the viewer, with one eye, and at the tree of which dimensions are to be estimated with the other. The result is a combined image of the tree and the length scales. By moving the slide viewer, the line with the best fit is selected. It must correspond with that part of the tree to be estimated, either vertically or horizontally. The estimate in metres can then be recorded directly from the slide.

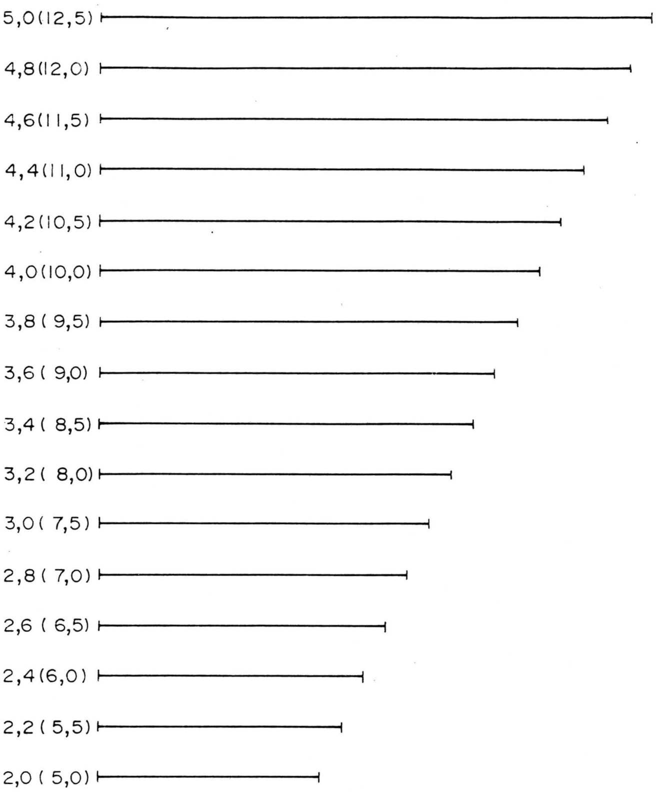

Figure 1 Length scales for linear estimates of 2,0–12,5 m.

The dimension meter, as it will be called, was calibrated to estimate dimensions of 2,0–12,5 m. Additional slides can be made to cover different ranges and scales according to need. The distance from the tree from where the reading should be taken, termed the observation distance, is critical and must be predetermined. For each length line in Figure 1, two values in metres are supplied. Dimensions of 2,0–5,0 m are estimated from a shorter observation distance than dimensions of 5,0–12,5 m (in brackets).

The observation distances must be determined for each slide, as they are dependent on the size of the reproduced image on the slide. By fitting the 2,0-m and 5,0-m representative lines exactly on 2,0-m and 5,0-m calibration poles, respectively, the observation distances can be determined by measuring the distances between the slide, and thus the operator, and the calibration poles. Provided the length scales occupy the main part of the slide, the two observation distances should be approximately 14,0 m and 34,0 m, respectively.

The measuring increments for trees up to 5,0 m and larger than 5,0 m are 0,2 m and 0,5 m, respectively, (Figure 1). Interpolation should be used if the part of the tree to be estimated falls between two lines.

The accuracy of the dimension meter was tested by comparing its estimates with actual measurements. The test was done in two parts. For the first test, 20 trees with heights between 2,0 and 5,0 m were selected. The true tree heights were measured with poles and a measuring tape. Subsequently, the heights of the same trees were estimated with the dimension meter. The two data sets were then tested for correspondence. A highly significant ($P \leq 0{,}01$) correlation ($r = 0{,}99$; $r^2 = 0{,}98$) between the true tree heights and the meter estimates was found. The average absolute difference between the true tree heights and meter-estimated heights was 0,06 m, which is only 1,74% of the average tree height of the 20 trees.

In the second test, 20 positions between 5,0 and 12,5 m were marked on a water tower, which was used to facilitate accurate measurements up to 12,5 m. The height of each position was measured with a measuring tape and subsequently estimated with the dimension meter. A highly significant ($P \leq 0{,}01$) correlation between the true heights and meter estimates was found again ($r = 0{,}99$; $r^2 = 0{,}98$). The average absolute difference between the true heights and meter-estimated heights was 0,14 m, which is 1,56% of the average height of the 20 positions.

The dimension meter tended to slightly over-estimate heights in test two, although this was non-significant. The fact that all measurements were taken from the same position could account for this, since, in the case of test one, where a different tree was measured each time, the dimension meter showed no bias.

The conclusions reached from these results are that the dimension meter produces very accurate results, and with the ease and speed with which large trees are measured, the dimension meter will certainly be a valuable addition to surveying methods. The most serious problem encountered with the dimension meter is obstruction by other trees in very dense situations, but this also applies to other indirect methods. A second problem encountered was tall grass obscuring stem bases and seriously interfering with the estimates. A simple solution was to place a brightly painted rod of 1,0 m against the stem base. Estimates are then taken from the top of the rod, and 1,0 m is added to the estimates. Horizontal estimates are generally easier to make than vertical estimates.

Acknowledgements

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Vegetation response to wagon wheel camp layouts

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Wagon wheel camp layouts have been favoured, in some quarters, for rotational grazing due to the economy and convenience of having the camps radially arranged around central facilities. A possible disadvantage of such layouts is the tendency for over-grazing near the hub and under-grazing at the extremities. The recent construction of three wagon wheel camp layouts on a farm near Kimberley provided the opportunity for a survey of the state of the vegetation. Two of the wagon wheel cells exhibited a low beta diversity while a higher beta diversity in the third cell was characterized by annuals and other weedy species near the hub, which was established at a previously existing watering point.

Wawielstelsels as kampuitleg het bepaalde voordele aangesien dit ekonomies en gerieflik is om kampe speeksgewys om sentrale geriewe te rangskik. 'n Moontlike nadeel van sulke stelsels is die neiging tot oorbeweiding naby die middel en onderbeweiding op die verste gedeeltes. Die onlangse uitleg van drie wawielstelsels op 'n plaas naby Kimberley het dit moontlik gemaak om 'n opname van die plantegroeitoestand te maak. Twee van die wawielstelsels het 'n lae beta diversiteit vertoon terwyl die derde se hoër beta diversiteit gekarakteriseer is deur die voorkoms van eenjarige plante en ander onkruidspesies naby die middel wat op 'n reeds bestaande watervoorsieningspunt opgerig is.

Additional index words: Piosphere, beta diversity, overutilization, underutilization, species turnover.

In this study the so called piosphere effect — the more or less radial vegetation pattern generated by localized concentrations of livestock (Baker, 1979) was addressed. In South Africa, where rotational grazing is generally recommended, the adoption of a wagon wheel camp layout (Savory, 1978) might conceivably lead to heavy centripetal and light or non-existent centrifugal use of the veld. The consequence, especially if the camps are long, might be veld deterioration about the hub. Degradation, or at least wastage, of forage resources at the extremities of the camps might also arise.

The development of three wagon wheel cell layouts on a farm near Kimberley provided the opportunity to describe the pattern of the vegetation, as a basis for evaluating possible piosphere development with continued practice of the Savory system. It would of course have been ideal to have included in the study continuous and conventional grazing systems since concentrations of animals are inevitable. Clearly the grazier would like to know the relative use, wastage, or despoilation of resources under the different options of grazing system. However, documentation of the spatio-temporal pattern of vegetation in relation to only the

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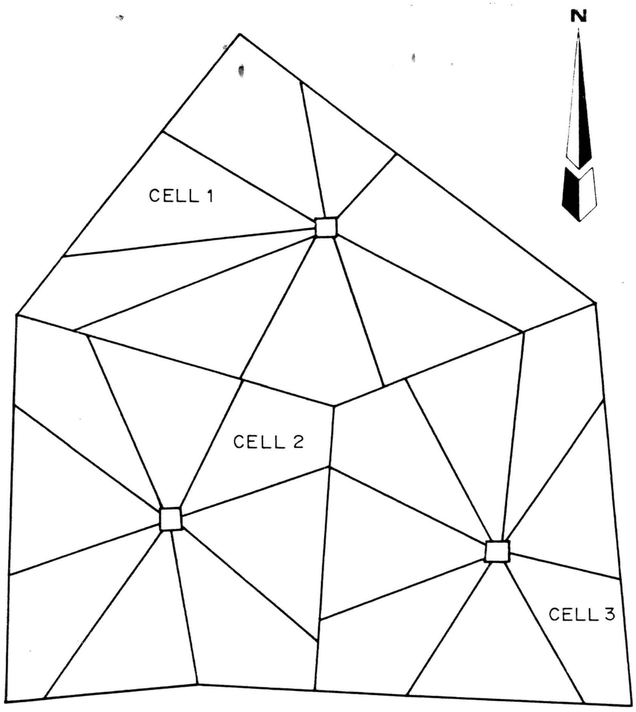

Figure 1 Arrangement of the three cells on the farm.

Savory system was considered to be of sufficient merit to warrant study.

Study Area

The study was conducted on the farm Rooipoort, located 65 km west of Kimberley and in Acocks's (1975) Kalahari Thornveld invaded by karoo. The soil, for the most part, consists of Kalahari sand and calcite and can be classified as an Aridesol. Savory's (1978) wagon wheel rotational grazing and resting system was implemented in 1984 and three 8-camp cells were laid out (Figure 1).

Data collection

Five transects were located in each cell, radiating from the hub. No more than one transect was positioned in any one camp. Sample plots, 50 × 50 m, were systematically located along the transects at 500-m intervals. The following parameters were measured in each sample plot: (i) herbaceous vegetation — species of nearest live plant to 100 step points were recorded; (ii) woody vegetation — the nearest species in each quadrant from 25 systematically located points using the Point Centre Quarter (PCQ) method; (iii) disturbance — number of dung pats and spoor present in 10 randomly placed 1 × 1 m quadrats; (iv) soil — samples taken with an auger; (v) distance from the hub; and (vi) slope and aspect.

Soil analysis

The soil pH, texture, conductivity, and cation exchange capacity (CEC) were measured, as were the concentrations of P, K, Ca, Mg, and Na. The analyses were conducted by Matrolab (Pty) Ltd using the standard techniques.

Data analysis

The data were ordinated using the detrended correspondence analysis (DCA) and the reciprocal averaging (RA) options of DECORANA; and classified using the Two-way indicator species analysis — TWINSPAN (Gauch, 1982). Direct gradient analysis was performed for the most common species, on the various soil parameters and on the disturbance data.

The soil, for the most part, was found to be slightly acidic and loamy sand in texture, except for a few sample plots in cell 3 which had a slightly alkaline pH and others in cell 2 which had a texture of sandy clay loam. The CEC of the soil was low and was probably due to the low clay and humus fractions of the soil.

Fifteen species of graminoids were identified and of these *Stipagrostis obtusa, Eragrostis lehmanniana* and

Table 1 List of species occurring in the three cells

Graminoid species	Woody species	Forb species
Aristida congesta	*Acacia mellifera*	*Gisekia afrikana*
Aristida diffusa	*Acacia tortilis*	*Indigophera daleoides*
Brachiaria nigropedata	*Asparagus afrikana*	*Limneum fennestratum*
Cynodon dactylon	*Boscia albitrunca*	*Ornoglossum viride*
Eragrostis lehmanniana	*Grewia flava*	*Pteronium* spp.
Eragrostis obtusa	*Lycium* spp.	*Solanum* spp.
Hyparrhenia hirta	*Rhus ciliata*	*Tribulus terrestris*
Pennisetum spp.	*Tarchonanthus camphoratus*	
Pogonarthria squarrosa		
Sporobolus fimbriatus		
Stipagrostis ciliata		
Stipagrostis obtusa		
Stipagrostis uniplumis		
Themeda triandra		
Tragus racemosus		

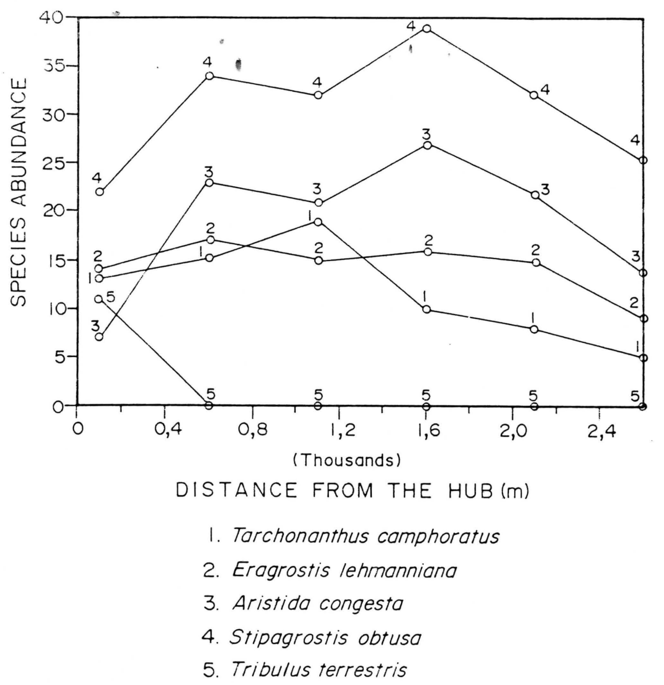

Figure 2 DGA of the major species.

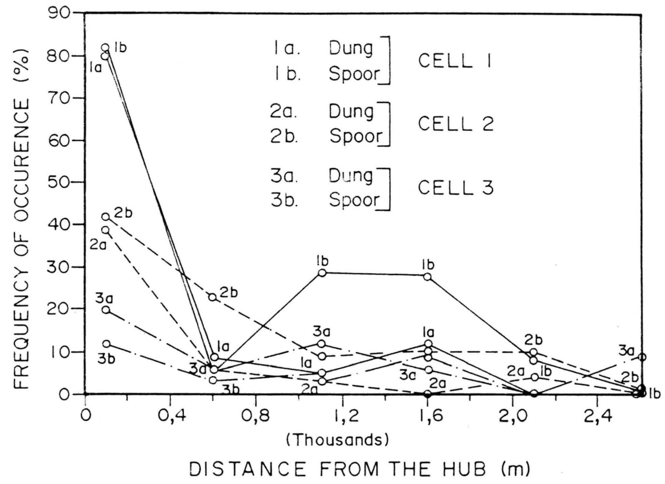

Figure 3 DGA of disturbance.

Aristida congesta were the most common species occurring in all three cells (Table 1). The forb *Tribulus terrestris* was found in the plots closest to the hub in cells 1 and 2 but not at all in cell 3. Eight woody species were recorded and of these *Tarchonanthus camphoratus* and *Rhus ciliata* were the most common in all the cells (Table 1). Cells 2 and 3 had an even spread of woody vegetation in the camps whereas in cell 1 the woody vegetation was concentrated within a kilometre from the hub, giving way to grassland as the distance from the hub increased.

Direct gradient analysis (DGA) was performed on the 5 major species (Figure 2). *Aristida congesta* and *Stipagrostis obtusa* were sparsest about the hub, while *Tribulus terrestris* abounded near the hub. The abundance of these same species was not related to any particular soil parameter gradient, so their DGA data were therefore not included in this note.

Dung and disturbance were related to 'distance from the hub' (Figure 3). The amount of disturbance was greatest at the hub in all 3 cells, and decreased in intensity as the distance from the hub increased. Since the changes in abundance, or frequency of occurrence, of species cannot be related to any of the measured

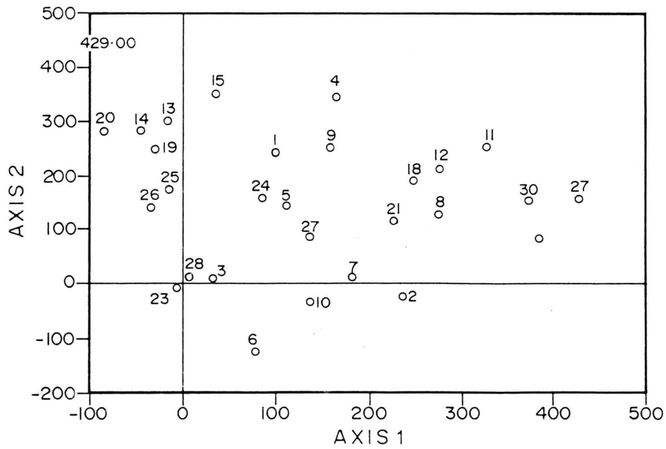

Figure 4 Species ordination. Key: 1. *Acacia mellifera*; 2. *Acacia tortilis*; 3. *Aristida congesta*; 4. *Aristida diffusa*; 5. *Asparagus afrikana*; 6. *Boscia albitrunca*; 7. *Brachiaria nigropedata*; 8. *Cynodon dactylon*; 9. *Eragrostis lehmanniana*; 10. *Eragrostis obtusa*; 11. *Gisekia afrikana*; 12. *Grewia flava*; 13. *Hyparrhenia hirta*; 14. *Indigophera daleoides*; 15. *Limneum fennestratum*; 16. *Lycium* species; 17. *Ornoglossum viride*; 18. *Pennisetum* species; 19. *Pogonarthria squarrosa*; 20. *Pteronium* species; 21. *Rhus ciliata*; 22. *Solanum* species; 23. *Sporobolus fimbriatus*; 24. *Stipagrostis ciliata*; 25. *Stipagrostis obtusa*; 26. *Stipagrostis uniplumis*; 27. *Tarchonanthus camphoratus*; 28. *Themeda triandra*; 29. *Tragus racemosus*; 30. *Tribulus Terrestris*.

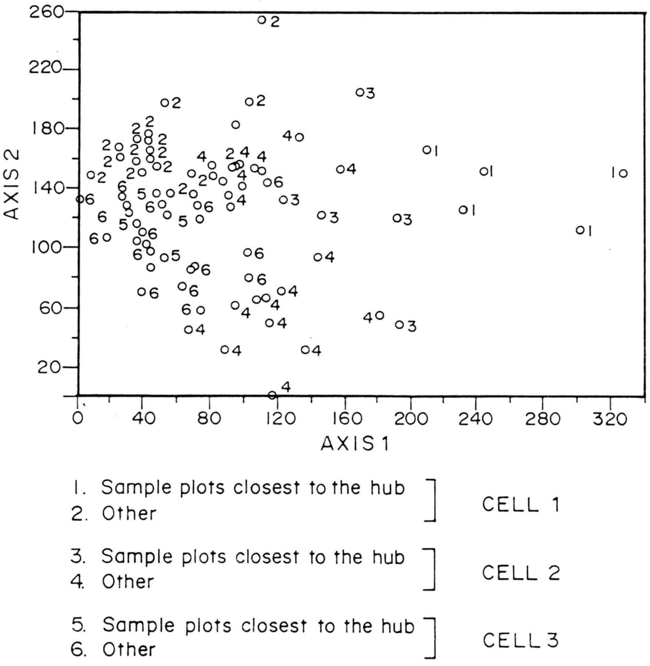

Figure 5 Sample ordination.

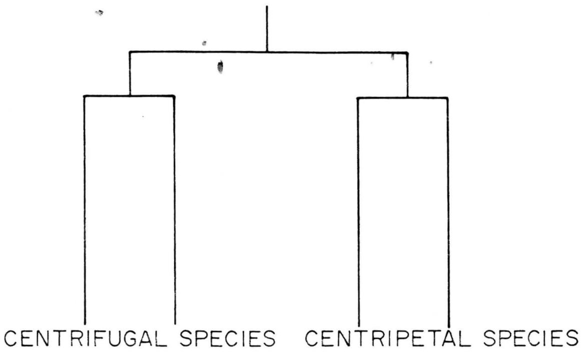

Figure 6 Dendogram showing the cluster analysis of the species.

variables, they may simply be the result of chance factors such as seed dispersal, seed viability, and stochastic events.

Outputs from DCA and RA were similar except that DCA gave a less congested overview and therefore only the DCA is discussed hereafter. Axes 1 and 2 combined accounted for 66% of the variation while axis 1 on its own accounted for 45% of the total variation in the data matrix.

The beta diversity of the vegetation, for 3 cells combined, was 3,27 SD, approximately ¾ of a species turnover. When the data for each cell was ordinated separately the beta diversity for cell 2 was 1,99 SD and for cell 3 was 1,95 SD — only ½ a species turnover. The beta diversity of cell 1 alone, however, was 3,05 SD and the inference was that the vegetation in cell 1 varied over a greater range than in the other two cells. Species and sample ordinations (Figures 4 and 5) did not indicate, in the plane of the first and second axes, any pattern except that the plots closest to the hub in cell 1 were distinct from all the other sample plots (Figure 5). When the data for cell 1 were ordinated separately the regression of distance from the hub on plot score on the first axis, a relation was apparent ($r^2 = 0,74$). Distance from the hub was therefore the primary environmental correlate of the pattern of the vegetation in cell 1. For cells 2 and 3 no regressions could be fitted to the data and no relationship was seen to exist between the first axis of variation in the vegetation and distance from the hub.

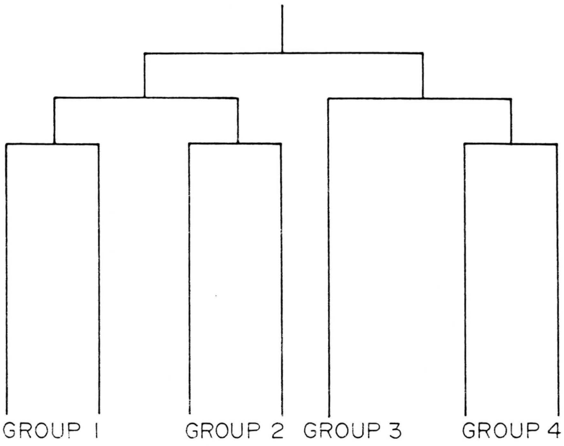

Figure 7 Dendogram showing cluster analysis of the sample plots.

The species classification tended to partition species centrifugally and centripetally in the cells (Figure 6). The samples classification separated the plots according to cell and distance from the hub (Figure 7). Sample plots from all cells were found in all groups. Groups 1 and 4 did not contain any of the sample plots closest to the hub, while group 2 contained the plots closest to the hub for cell 3 and group 3 the plots closest to the hub for cells 1 and 2. It can therefore be inferred that the plots closest to the hub are more similar in cells 1 and 2 than they are with plots from cell 3.

The overall beta diversity of about 3 SD (or ¾ species turnover) across the three cells corresponds with growing local experience. It seems that within any given small region, variation in defoliation intensity, from light to severe will bring about a species compositional difference of about 2 SD (or ½ species turnover) (e.g. Hardy, 1986). Coupling the variation in grazing intensity (from severe at the hub to scant at the cell periphery) with minor topographical, pedological, and historical variation, a small beta diversity is expected. Indeed, in the circumstances, it is hardly to be expected that direct gradient analysis would yield dramatic responses of individual species to environmental gradients. Aside from close proximity to the hub (in the case of cell 1) the data exhibited no strong pattern in relation to either animal concentration or other environmental factors.

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