CHAPTER 8

AN ANALYSIS OF THE COMPETITIVE INTERFERENCE IN *ANTHEPHORA PUBESCENS* NEES IN A NATURAL PLANT COMMUNITY

INTRODUCTION

An understanding of the response of desired and undesired key species, to the separate and combined pressures of a variable physical environment, is essential to the manipulation of rangeland vegetation to achieve a given objective. Such knowledge includes the conditions required for a species to establish from seed, to reach maturity and to produce seed, or the conditions that are likely to lead to large - scale mortality. In addition to such knowledge, an understanding of how management can affect the competition is necessary.

According to Teague (1989) results of direct gradient analysis, ordination and classification suggest that a given environment, mainly due to its physical characteristics, disposes a relatively predictable species association. A given species occurring in a predictable association may quite likely occur with another group of species under different conditions in another environment. Such a state will arise as long as individuals have tolerance limits which encompass a range of conditions, individuals within a species differ ecologically from each other, different species differ in their tolerance levels, and conditions vary as gradients in space (Teague 1989). Just as the relative importance of species vary in space, their patterns of abundance change in time. In either case the species will only occur if it is capable of reaching a location, the resources and conditions are appropriate, and predators and competitors do not preclude it. Noble & Slatyer (1981) attempted to formulate the role of different features, of different species, which determines their place in succession. The two most important features relate to the method of recovery and the ability of individuals to reproduce in the absence of competitors. According to Harper (1977) species react to selection pressure and develop features which enable them to survive for a longer period in the succession or they may develop more effective mechanisms of escape.

A species' ecological features, abiotic tolerance, maximum relative growth rate, phenology, receptiveness to various enemies and relative competitive ability can be summarised by the niche concept. The behaviour of a plant growing in isolation differs greatly from its behaviour in the presence of other plants and enemies. The competitive ability of a species is therefore not only a feature of the genetic potential of the species itself, but also depends on the environmental conditions, other plants and the consumers involved. For every combination of soil, climate, altitude, slope and aspect there will be one species that grows better than another species, so that it produces more seeds or occupies more space by vegetative spread. In a spatially uniform and temporally constant world this single species would dominate the community to the exclusion of all others (Teague 1989). Most plant communities do, however, consist of many species, and the environment is not spatially uniform nor temporally constant.

Anthephora pubescens Nees is an important component of permanent pastures in the Cape Province north of the Orange River. In its natural state A. pubescens is prevalent on sandy soil with a neutral pH (Donaldson et al. 1972). A valuable attribute of A. pubescens is its relatively low sensitivity to poor soil nutritional conditions (Fourie et al. 1987). Little study has, however, been done to examine the competitive ability of A. pubescens in a natural population. The objective of this study was therefore to examine the occurence frequency of A. pubescens in the presence of other species, in a natural plant community.

MATERIALS AND METHODS

The study area is located at the Biesiesvlakte Research Station, Vryburg (24° 28" E; 25° 57" S). The research station lies 1 208 m above sea level and has a mean annual rainfall of 475 mm. The soil is characterised by 92.7 % sand, 4.9 % loam and 2.4 % clay and has a pH of 6.64. The survey was conducted in a natural plant community in April 1991. A sample of two hundred points was taken using the nearest - neighbour method (Yeaton & Cody 1976). At each point, A. pubescens was used as the reference tuft from which measurements were made. Four sets of measurements were made in the field. Firstly, nearest - neighbour distances, i.e. the distance between the reference A. pubescens tuft and the nearest neighbour. Secondly, the diameter of each tuft was measured (mm). Thirdly, the nearest neighbour was identified. Lastly, the percentage occurrence of the different species in the plant community was determined.

It is of importance in studies of spacing and competition to choose sites in which the limiting resource is evenly distributed. For example, on slopes where the ground surface shows run - off channels, water is unevenly distributed. Studies carried out on such sites therefore must take in account the considerable variations in water availability (Barbour 1973). For this reason a level site was selected for the present study, where the substrate was uniform and coarse and where run - off channels were not visible on the surface; situations at the feet of slopes, where run - off water might be directed on to the site, were avoided.

The nearest - neighbour distances and the sizes of the nearest neighbours were analysed as follows: nearest - neighbour distances were regressed against the sums of the size indices for each pair. The question as to whether the distance between neighbours may be less if they belong to different species than if they belong to the same species, was approached as follows: the larger of the two individuals, of the nearest - neighbour pair, was regarded as determining the size of the other. Since the latter could vary according to distance from the larger individual, the ratio of the size of the smaller individual to the distance from its neighbour was calculated. These ratio's are referred to as arbitrary size index values (ASIV). Ratio's for intraspecific pairs were compared to those for interspecific pairs. Regression analyses were applied and statistical significance was tested at a level of $p < 0.05$ (Rayner 1969).

RESULTS AND DISCUSSION

It must be kept in mind that in the interpretation of all the results, A. pubescens is used as the vantage point; none of the other grass species or forb species were analysed to determine their respective competitive abilities.

1. PERCENTAGE OCCURRENCE

The species recorded for the plant community surveyed is represented in Table 1. It was evident that A. pubescens was the dominant species; A. pubescens constituted almost 80 % of the plant community, while the rest was mainly constituted by other grass species, Stachys spathulata, a forb, being the exception.

Table 1 The total number of individuals of grass species recorded (nomenclature follows Gibbs Russel et al. 1990) and their relative percentage frequency in an *Anthephora pubescens* community at Biesiesvlakte Research Station (24° 28" E; 25° 57" S)

Plant species	Total number recorded	Relative percentage frequency
Anthephora pubescens Nees	159	79.5
Schmidtia pappophoroides Steud.	23	11.5
Eragrostis lehmanniana Nees	4	2.0
**Stachys spathulata* Burch. ex Benth.	4	2.0
Aristida meridionalis Henr.	2	1.0
Pogonarthria squarrosa (Roem. & Schult.) Pilg.	2	1.0
Stipagrostis uniplumis (Licht.) De Winter	2	1.0
Aristida species	1	0.5
Hemarthria altissima (Poir.) Stapf & C.E. Hubb.	1	0.5
Themeda triandra Forssk.	1	0.5
Tragus koelerioides Aschers.	1	0.5

* Forb

Besides A. pubescens, Schmidtia pappophoroides was the most frequent species occurring significantly more often than the other species in this particular plant community ($p < 0.05$). Anthephora pubescens rarely occurred in the vicinity of other dominant grass species.

2. REGRESSION ANALYSES

On basis of the above results, the data were divided into two groups: (a) regressions between A. pubescens pairs (intraspecific competition) and (b) regressions between A. pubescens and S. pappophoroides pairs (interspecific competition).

a) Intraspecific competition

The relationship between nearest - neighbour distances and the sums of the size indices of A. pubescens pairs is illustrated in Figure 1. A regression could not be fitted, i.e. a significant relationship was not exhibited ($p < 0.05$). Neither was a significant relationship between the ASIV and nearest - neighbour distances of A. pubescens pairs exhibited (Figure 2).

b) Interspecific competition

The relationship between nearest - neighbour distances and the sums of the size indices of *A. pubescens* and *S. pappophoroides* pairs is illustrated in Figure 3. A significant relationship was not evident in the interspecific pairs ($p < 0.05$). Neither was a significant relationship exhibited between the ASIV and nearest - neighbour distances of *A. pubescens* and *S. pappophoroides* pairs (Figure 4; $p < 0.05$).

It was evident from the percentage occurrence survey that *A. pubescens* occurred most often in the vicinity of other *A. pubescens* tufts, while other grass species virtually failed to occur in the vicinity of *A. pubescens* tufts. In the interpretation of these results one is faced with two possible reasonings. If *A. pubescens* is considered a pioneer species in the evolutionary pathway of plant succession, then *A. pubescens* could be classed as a species belonging to the facilitation or tolerance models (Connell & Slatyer 1977); i.e. *A. pubescens* is an early coloniser but dies out due to competition from invading superior competitors. If this be the case, then according to Harper's (1977) view *A. pubescens* should be a good coloniser but may be a poor competitor. *Anthephora pubescens* is known to establish well on nutrient poor soil (Fourie *et al*. 1987). This characteristic may clarify the good colonizing ability of

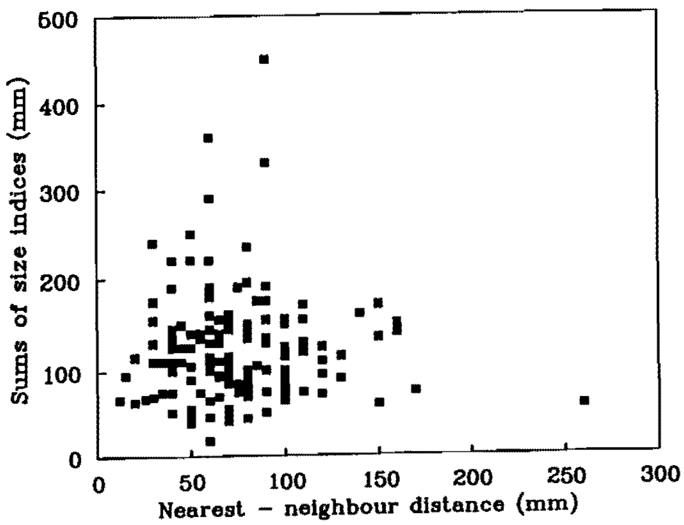

Figure 1 The relationship between the nearest - neighbour distances and the sums of the size indices of Anthephora pubescens pairs in a natural plant community ($y = 117.39x + 0.001$; $r = 0.184$; $p < 0.05$).

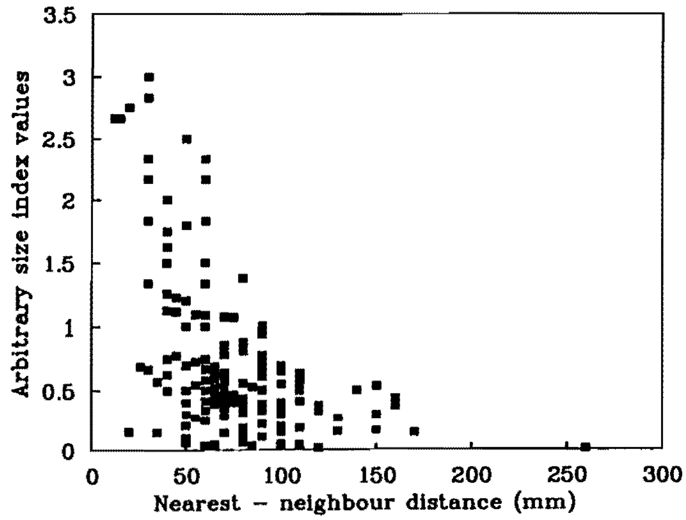

Figure 2 The relationship between the nearest - neighbour distances and the arbitrary size index values (ASIV) of Anthephora pubescens pairs in a natural plant community ($y = 1.465x - 0.015$; $r = 0.182$; $p < 0.05$).

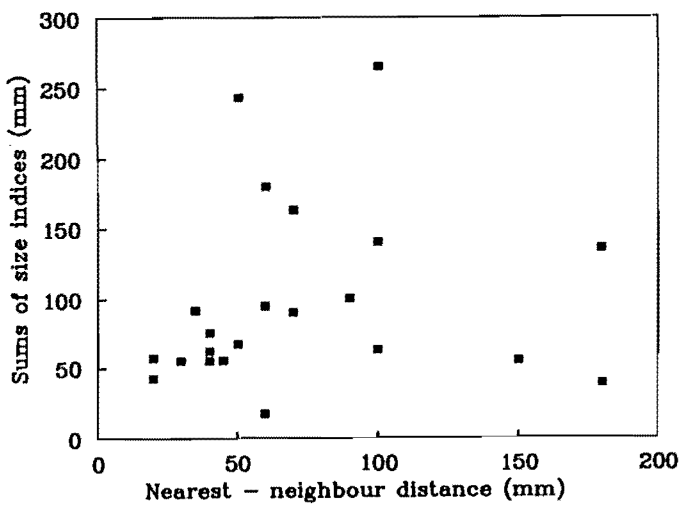

Figure 3 The relationship between the nearest - neighbour distances and the sums of the size indices of Anthephora pubescens and Schmidtia pappophoroides pairs in a natural plant community ($y = 81.6x + 0.198$; $r = 0.106$; $p < 0.05$).

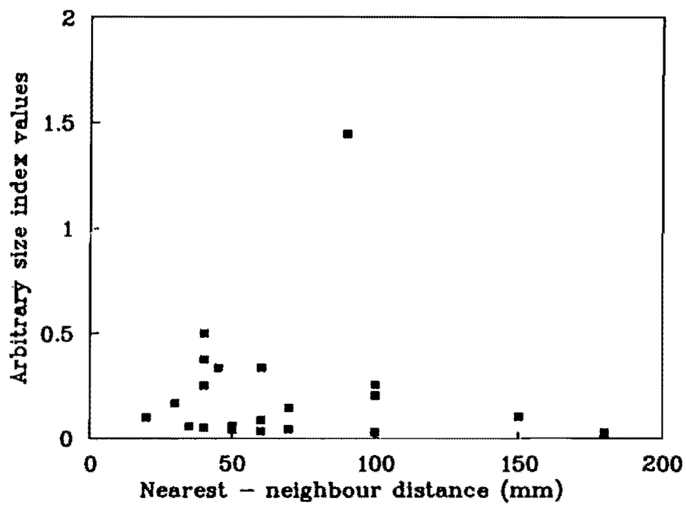

Figure 4 The relationship between the nearest - neighbour distances and the arbitrary size index values (ASIV) of Anthephora pubescens and Schmidtia pappophoroides pairs in a natural plant community ($y = 0.230x - 0.003$; $r = 0.108$; $p < 0.05$).

A. pubescens, and the poor competitive ability of A. pubescens has been illustrated by Mynhardt et al. (1992).
If one considers this reasoning to be the appropriate one, then the population surveyed must be in an early successional stage and one would expect S. pappophoroides to increase in number to the detriment of A. pubescens and become the dominant species.

If A. pubescens is, however, considered to be a decreaser in a plant community - according to Dankwert's (1989) classification of a decreaser where the species decreases in abundance when the pasture is overgrazed or undergrazed - then A. pubescens occurs later in the successional sequence. It could therefore be that A. pubescens is a strong competitor which resists invasion from other grass species. It is therefore apparent that a verdict cannot be given pertaining to the competitive ability of A. pubescens in a natural plant community based on the given results.

The reason as to why a significant relationship was not exhibited between nearest - neighbour distances and the sums of the size indices and ASIV of both intraspecific and interspecific pairs is not evident. It may be accrued to the method used in the present survey. A mature A. pubescens tuft is characterised by tissue death from the center of the tuft outwards. An originally single tuft therefore becomes divided forming separate smaller tufts with time. In the present survey the smaller tufts were considered as separate tufts and neighbours, as they form their own root system and are able to grow independently, allowing other species to establish in the areas between the small tufts. The results may therefore have been confounded due to these complexities which are prominent in a mature A. pubescens tuft.

CONCLUSIONS

It may only be concluded that competitive interactions were prevalent in the particular plant community. It must, however, be kept in mind that the results presented are from a single survey and can not be considered as representative of all natural plant communities. The method used is evidently not suitable to determine potential competitive ability in a natural plant community and should therefore be revised. Further investigation is evidently necessary, where the relationships between A. pubescens and the other dominant grass species in the particular community, must be determined before any conclusions can be made of the competitive ability of A. pubescens in a natural plant community or any management strategy be devised. Essential characteristics which determine the ecology of a species can only be determined by studying the reactions of individuals to neighbouring individuals. The behaviour of an individual in isolation may therefore be irrelevant to understanding the individuals behaviour in a community.

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