Fractal Characteristics of the Distribution Pattern of *Ceratoides arborescens* Populations from Inner Mongolia Grassland

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Key words : pattern , fractal dimension , ecological unoccupied dimension , *Ceratoides arborescens*

Introduction *Ceratoides arborescens* is a long-lived , cold-resistant and drought-resistant perennial subshrub , which plays an important role in Inner Mongolia . Traditional approaches to describing and interpreting spatial distributions of *Ceratoides* species have focused on the patterns either of species zonation or of species diversity . In this paper , we discussed the method of fractal analysis , and tried to explain : Whether patterns of *C . arborescens* populations have the similar detail over a range of scales ? To address this problem and to measure the complexity of pattern structure , a fractal approach must be used .

Materials and methods *C . arborescens* is widely distributed along Inner Mongolia grassland . Six study plots , P1 , P2 , P3 , P4 , P5 and P6 are chosen in *C . arborescens* communities of different vegetations on Inner Mongolia grassland . At each plot , eight contiguous 20 m × 20 m quadrats are established . Tree height , crown size , and the x and y coordinate of individuals are measured . Fractal dimension (D_b) is calculated using the box-counting method .

Results Figure 1 shows that each log (ε)-log N (ε) curve can be subdivided into two sections characterized by different slopes and scale ranges . The scale size of inflexion points is better significance .Table 1 shows that at the significance level of 0 .01 , the fractal dimensions for the distribution patterns of *C . arborescens* populations in P1 , P2 , P3 , P4 , P5 and P6 are 1 .386 , 1 . 377 , 1 .616 , 1 .512 , 1 .087 and 1 .049 , respectively . In the order of P3 > P4 > P1 > P2 > P6 > P5 .The scale size of inflexion points for P1 , P2 , P3 and P4 are 2. 857 m , 2. 500 m , 2. 857 m and 2. 500 m ,while that for P5 and P6 are 1. 333 m. The mean crown sizes of *C . arborescens* individuals in P1 , P2 , P3 , P4 , P5 and P6 are 1. 432 , 1. 178 , 0. 965 , 0. 601 , 1. 154 and 1. 809 m , respectively . These indicate that the capacities of spatial occupation of different populations are variable .

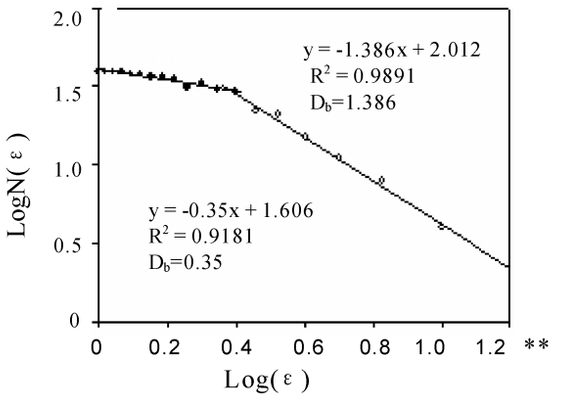

Figure 1 *Box-counting dimension of P1 population .*

Table 1 *Box-counting dimensions of* C . arborescens *population patterns in different grassland types .*

plot number	box-counting dimension	correlation coefficient	inflection point(m)	mean crown width(m)
P1	1 .386	0 .989 **	2 .857	1 .432
P2	1 .377	0 .920 **	2 .500	1 .178
P3	1 .616	0 .983 **	2 .857	0 .965
P4	1 .512	0 .984 **	2 .500	0 .601
P5	1 .087	0 .970 **	1 .333	1 .154
P6	1 .049	0 .937 **	1 .333	1 .089

** Effects of periods on all variables were significant ($p < 0.01$)

Conclusions The patterns of *C . arborescens* populations could be thought of as fractals as they exhibit self-similarity within the range of scale considered . Their fractal dimensions are not integer but fractional , ranging from 1 .049 to 1 .616 . The results showed that the spatial distributions of P3 and P4 were high (1 .616 and 1 .512 near 2) in different types of *C . arborescens* , which reflected the high spatial occupation degrees of the populations as the dominant species of these grassland types . The order of spatial occupation degree was P3 > P4 > P1 > P2 > P6 > P5 , which reflected the variation of functions and positions of *C . arborescens* population in different grassland types .

Reference

Sugihara G and May RM .(1990) .Applications of fractals in ecology . *TREE* , 5 (3) :79～86 .