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A. Wallace
Laboratory of Nuclear Medicine and Radiation Biology, University of California, Los Angeles, California 90024

E. M. Romney
Laboratory of Nuclear Medicine and Radiation Biology, University of California, Los Angeles, California 90024

J. E. Kinnear
Laboratory of Nuclear Medicine and Radiation Biology, University of California, Los Angeles, California 90024

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FREQUENCY DISTRIBUTION OF THREE PERENNIAL PLANT SPECIES TO NEAREST NEIGHBOR OF THE SAME SPECIES IN THE NORTHERN MOJAVE DESERT

A. Wallace¹, E. M. Romney¹, and J. E. Kinnear¹

Abstract.—Frequency distribution patterns were developed for distance to nearest neighbor of the same species for Larrea tridentata (Sesse & Moc. ex DC.) Cov., Ephedra nevadensis S. Wats., and Acamptopappus shockleyi A. Gray. The distances between shrubs had been determined previously in another study. About one-third or more of the nearest neighbor of its own kind was within less than one meter for each species, indicating that it was usually within the same shrub clump, which in turn is indicative of an aggregating effect. For L. tridentata and E. nevadensis much of this could be from the same original plant by crown diffusion (L. tridentata) or underground spreading (E. nevadensis). None of the three gave evidence of spacing at regular intervals when the nearest neighbor of a single individual within a shrub clump was outside that clump. Rather, they appeared to be randomly distributed under this condition, except possibly for A. shockleyi.

Nearest neighbor information among perennial plants is of considerable importance in desert environments. Involved is the tendency of a given system to have regulatory mechanisms that can space plants at quite regular intervals. This is observed with Larrea tridentata (Sesse & Moc. ex DC.) Cov. with limited rainfall (Barbour 1969); the more sparse the rainfall, the greater is the spacing. In our previous studies of plant populations in the northern Mojave Desert some entire populations had been subjected to a census, and from the data nearest neighbor relationships had been calculated (Wallace and Romney 1972d). In the previous work, the mean distance and standard deviation to the nearest neighbor of any species and of the same species were reported for 23 perennial shrubs. In general the coefficient of variation for the distance to nearest neighbor of the same species of the perennial plants was around 100 percent.

Barbour's (1969) work indicated that L. tridentata spacing could be random, clumped or at regular intervals depending on the climate. The purpose of this report was to determine how this species was spaced in part of the Nevada Test Site and to get similar data for other species.

Materials and Methods

The site of the study area is Mercury, Nevada, near waste water ponds from the local sewage processing system. The soil at this site is underlain by a virtually impervious hardpan layer at depths varying from 15 to 75 cm.

Perennial plants grow both singly and in clumps, separated by bare areas of desert soil (Fig. 1). The size and spacing of the clumps is irregular, and several different species may grow together in a single clump (Fig. 2). A census was made in the summer of 1968 of all perennial plants (including shrubs, grasses, herbs, and their seedlings) in 25 circular experimental plots, each plot being 30.5 m in diameter. Each plant was categorized as to its species and its vegetational unit membership. This census effort involved more than 19,000 individual plants representing 28 different species.

A special method was devised for locating and cataloging each plant in each plot. A permanent standpipe for mounting a surveyor's transit was installed at the center of each plot, with a marker located on magnetic north at a distance of 15.25 m. Orientation for each vegetational unit was the measured

¹Laboratory of Nuclear Medicine and Radiation Biology, University of California, Los Angeles, California 90024
Fig. 1. View of northern Mojave Desert study site with typical shrub clumps separated by bare areas of desert pavement.

Fig. 2. Typical clumps of shrubs in group association (vegetational unit). Present are Acamptopappus shockleyi (3), Ambrosia dumosa (8), Ceraoides lanata (5), Grayia spinosa (1), Krameria parvifolia (1) and Lycium andersoni (1).
distance from the plot center to the vegetational unit center. The azimuth for each unit was measured from magnetic north to the center of the vegetational unit. The unit’s greatest and smallest width and its species content were recorded. Each species within a unit was measured in like manner, and it was further identified by height. These data were recorded and transferred to punch cards for computer processing.

The method for calculating distance to nearest neighbor is given in detail in the previous publication (Wallace and Romney 1972d).

RESULTS AND DISCUSSION

Frequency distribution histograms for distance to nearest neighbor of the same species for _L. tridentata_ Sesse & Moc. ex DC. (1241 individuals), _Ephedra nevadensis_ S. Wats. (386 individuals), and _Acamptopappus shockleyi_ A. Gray (3470 individuals) are in Figures 3, 4, and 5. The three species were chosen for their different growth habits. All three, however, tend to exist in clumps with individuals of other species as well as with other individuals of the same species, as is observed in each of the histograms. A high proportion of the nearest neighbor of the same species lies within a distance of 1.5 meters. A near normal type of frequency distribution existed within the clumps for the first 1.5 meters or so according to each of the figures.

About one-third of the _L. tridentata_ plants were within about two-thirds meter distance of one another. Part of this may be due to the breakup of crowns into more than one plant (Wallace and Romney 1972b). No attempt was made in the census to identify these as one plant, so a crown diffusion phenomenon existed within the first meter in the histogram in Figure 1.

Beyond the first clump or beyond a dis-
distance of one meter there was almost a constant number of individuals within each cell width out to 4 or 5 meters. There was a very slight tendency for a number of nearest neighbors to occur in the next adjacent clump, but data generally show distribution with different distances up to about 5 meters to the nearest neighbor within the study plots. This would imply that the clumps are very randomly distributed.

The mean distance of one *L. tridentata* to another *L. tridentata* was 2.15 meters. The mode was at 0.6 meters and, being left of the mean, is indicative of some aggregation. The skewness was -0.27 and the kurtosis was -15.77.

The *E. nevadensis* had the smallest population of the three species studied, and it was chosen for this reason. About one-half of the individuals were nearest neighbor within less than one meter. This may be related to the habit of propagation by underground roots (Wallace and Romney 1972a). These groups would be aggregated. In the census no attempt was made to separate such plant groups from those that were truly individual, so this may account for the large proportion of close neighbors. Beyond one meter the distribution appeared to be mostly uniform with distance and therefore random. There did seem to be a small distribution peak at about 3.6 meters, however.

The overall mean to nearest neighbor of *E. nevadensis* of the same species was 3.35 meters, with a skewness of 1.36 and kurtosis of 4.68. The mode was at 0.6 meters, which is to the left of the mean and would indicate aggregation as explained above.

The largest population of the three species was with *Acamptopappus shockleyi*. It has the tendency to grow both in groups within clumps of other species and as individuals in the space between clumps (Wallace and Romney 1980, this volume). This latter habit is the reason for its more negative association with other species (Wallace and Romney 1970).
The frequency distribution for *Acamptopappus shockleyi* is almost exponential, with numbers rapidly dropping off with distance. This is, of course, related to its relatively dense population. The data can be interpreted as the species being to a large extent aggregated. The mean distance between neighbors was 1.18 meters. The mode was at 0.6 meters. The skewness of the frequency distribution was 2.47 and kurtosis was 12.54.

The varied nature of the distribution of the individuals for each species may indicate that the site in question is not extremely limited in rainfall. Other sites in the northern Mojave Desert can be found that are more limited in rainfall, and spacing at regular intervals may be more likely at such sites. Because the study site involves a mixture of vegetation, it is quite unlikely that the forces that result in regular spacing have been in operation in this study area.

**Acknowledgments**

This study was supported by Contract DE-AM03-76-SF00012 between the U.S. Department of Energy and the University of California.

**Literature Cited**


![Fig. 5. Histogram of frequencies of distance to nearest neighbor of the same species in meters of 3470 *Acamptopappus shockleyi* plants in the northern Mojave Desert.](image-url)