IB 153L
Fall 2003

Lab 2: Quantifying spatial patterns

Background: Plant ecologists use a number of techniques to quantify and statistically analyze patterns of spatial distribution. Some use plots, while others are plotless. Those without plots typically measure the distance between randomly selected plants and their nearest neighbors. We will use several different methods to investigate the spatial distributions of two herbaceous plant species: the broadleaf plantain (*Plantago major*) and dandelion (*Taraxacum officinale*).

Field sampling instructions: Divide into two groups of 4. The groups will conduct the same exercises, but in different sites, providing replication of our analyses. All data sets will be shared by the entire class.

Nearest Neighbor Method

Use a tape measure (or Sonin distance measurer) to delineate a 10 x 10 m plot, in an area specified by the instructors. Mark the edges of the plot at 2 m intervals with colored flags. Using wooden popsicle sticks and a felt-tip pen, individually mark and number all plants of the target species within the plot. Record the total number of individuals in the plot. Randomly select 30 individuals in each plot and measure a) the distance to the nearest neighbor in centimeters (we will convert these measurements to meters for the analysis). [Note: if the nearest neighbor is outside the plot, measure to that individual] and b) the length of the longest leaf (to the nearest centimeter) in the rosettes of the target individual and its nearest neighbor.

[Question: What relationship would you predict between the maximum leaf sizes of neighboring plants? If a plant is large, is its neighbor likely to be large or small? Why?]

Contiguous Quadrats Method

Starting from a random point, census a series of contiguous (side-by-side) 1 m^2 quadrats along a transect line oriented in a stratified random compass direction. [Note: the instructors will determine the starting point, transect compass direction, and number of quadrats to be censused]. Count all individuals of the two target species in each quadrat.

Data Analysis: working collaboratively in your two groups, perform the following analyses on the data.

<u>Analysis of nearest neighbor data</u>: See Krebs, pp. 192-194 for nearest neighbor analysis equations. Calculate the mean number of target plants per square meter in the plot. To obtain the mean, divide the number of plants in each plot by the plot area (100 m^2). This value is your □ value in equation 6.2. Now calculate the mean distance to nearest neighbor (r_a) using equation 6.1, and the expected mean distance to nearest neighbor (r_e) using equation 6.2. [Note: these values must be expressed in meters, the same units as

plot density. So, be sure to shift the decimal point of mean distance in centimeters two places to the left before using it in your calculations). With those values, calculate the Index of aggregation (*R*). Does the *R* value suggest a clumped, random, or uniform distribution? Test the null hypothesis that this index equals one using equation 6.4.

Create a scatterplot of the mean size of the members of each pair of nearest neighbor target plants (Y-axis) versus the distance between them (X-axis). Determine the correlation coefficient for this relationship and evaluate its statistical significance (see table from B.17 from Zar).

<u>Analysis of contiguous quadrat data</u>: Enter the data into the *Ecological Methodology* software program using the "TTLQV" option under the "Spatial Pattern" heading. Using the calculated variances, plot a graph of variance (Y-axis) versus block size (X-axis). Using Figure 6.4 from Krebs (p. 205) as a reference, evaluate whether the target plants have clumped, random, or uniform distributions in each of the contiguous quadrat transects. Does variance peak at a particular block size? Is your conclusion from this analysis consistent with that from the nearest neighbor analysis?

Using these quadrat data, calculate the Index of dispersion (I = variance/mean) for both target species on each transect and test its significance (χ^2 = I (n-1); df = (n-1); see Fig. 4.5 on Krebs, p. 120). Do the patterns deviate from a Poisson distribution? In what direction?

Equipment:
Compass
Sonin distance measurer
30-m tape measure
Colored stake flags
Meter stick
metric ruler
Popsicle sticks
Felt-tip pen
Set of random numbers