

## Spatial Ecology Lab

The spatial distribution of animals and plants is extremely important to the understanding of their ecologies. Consider these two species of birds:



The birds on a wire are clustered, reflecting a predator-avoidance behavior of flocking together. The masked boobies (*Sula dactylatra*) are very evenly spaced, reflecting their need to defend nest space against other boobies, but also pack in as many nests as possible into a limited amount of space.

We will investigate patterns of spatial distribution using aerial imagery of trees from Barro Colorado Island (BCI), Panama and Joshua Tree National Park (JTNP) California.

The first image was taken on March 29, 2002, by the DigitalGlobe Corporation's QuickBird satellite at a resolution of better than 1m, of Barro Colorado Island, an important tropical research station in Panama. The image was obtained during the flowering season of the Guayacan (*Tabebuia guayacan*; Bignoniaceae) tree, a species which produces copious quantities of brilliant yellow flowers.



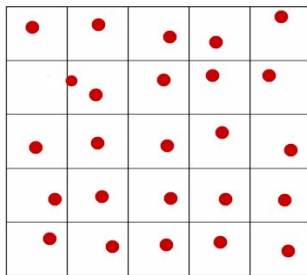
Each yellow dot on the image below is one tree. If you wish, you can

download the full image in jpg form from the course website.

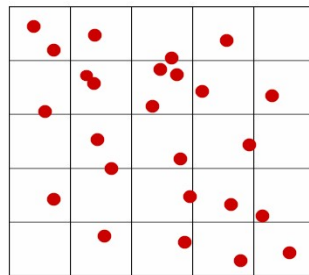


We are interested in addressing the question: Is the distribution of Guayacan trees regular, random, or clumped? The simplest metric to address this is the mean:variance ratio. If you divide the study area into a series of cells, and count the number of individuals in each cell, the mean:variance ratio will vary with the nature of the distribution. In the following “dispersed” diagram, each cell has approximately the same number of individuals, so variance in the cell counts will be low and mean/variance will be greater than 1. In the second, “random” diagram, the mean and variance of the cell counts will be similar and their ratio will be close to 1. In the third diagram, a clumped distribution means some cells will have many individuals and others few or none, so the variance will be high, and the mean/variance will be less than 1.

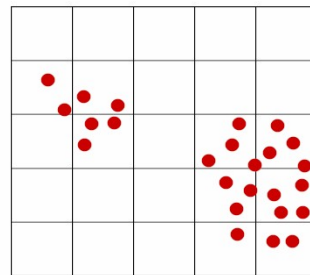
counts will be similar and their ratio will be close to 1. In the third diagram, a clumped distribution means some cells will have many individuals and others few or none, so the variance will be high, and the mean/variance will be less than 1.



Dispersed ( $m/v=12$ )



random ( $m/v=2$ )



Clustered ( $m/v=0.47$ )

**Procedure:**

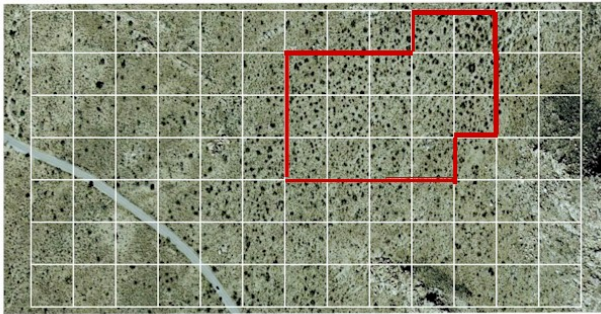
Download the image “BCI 100m grid.pdf” and open it in Adobe Reader (<http://get.adobe.com/reader/>) or another pdf viewer of your choice. Enlarge the image to 400% and pan over to the eastern end; the study area is approximately:



Count the number of Guayacan trees in each grid cell across a rectangular area of approximately 15 x 10 complete cells. Enter the data into an Excel spreadsheet. Use the usual Excel functions to compute the mean ( $T_{\text{mean}}$ ), the variance ( $T_{\text{var}}$ ) and the mean/variance for the data set (give your value for  $N_{\text{cells}}$ , the number of cells counted, also).

Now open the JTNP pdf image ( ), and enlarge the view to a convenient size. The dark plants are Joshua trees. Score the cells, as above, for the area approximately shown as:

## Joshua National Park



50 meter grid  
Longitude -116.23231 Latitude 34.069292

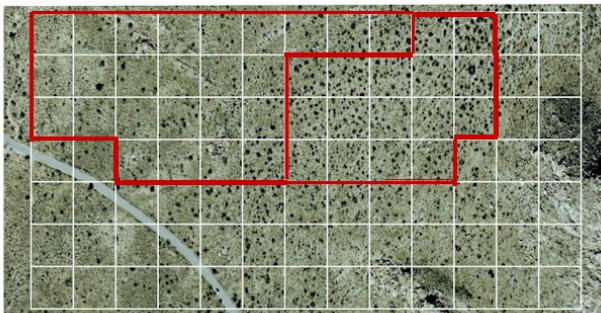


Source of Data MODIS (BR) | Data Posted October 6th 2009 | Prepared by W Roberts

And compute the mean:variance metric for the area.

Next, enlarge the study area to approximately:

## Joshua National Park



50 meter grid  
Longitude -116.23231 Latitude 34.069292



Source of Data MODIS (BR) | Data Posted October 6th 2009 | Prepared by W Roberts

Add in the additional cell scores and re-compute the metric for the whole, larger, study area.

## Questions:

**What are the values for  $N_{\text{cells}}$ ,  $T_{\text{mean}}$ ,  $T_{\text{var}}$  for the BCI Guayacan tress, and the JTNP Joshua trees?**

**What sort of distributions do these trees show? WHY do you think they show this kind of distribution?**

**With the JTNP data, how does the size of the study area influence your results? What does this tell you about selecting appropriate study areas?**