

The Effects of Habitat Fragmentation on the Remnant Plant Communities Within Metropolitan Phoenix: A Patch Level Analysis

Arthur Stiles and Sam Scheiner

Department of Plant Biology, Arizona State University

The vascular plant species within undeveloped remnant patches were sampled in order to assess the impact of habitat fragmentation on relict desert communities within the urban matrix of the CAP-LTER study area. Metropolitan Phoenix provides a unique opportunity for studying the ecological consequences of urban sprawl upon Sonoran Desert plant communities. The large spatial dimensions occupied by the city and its settlement patterns have allowed an abundant collection of parks and preserved areas, in a wide assortment of sizes, to remain intact.

This relatively high number of remnant patches will allow us to test for correlations of species diversity with a range of landscape level parameters, including spatial characteristics of the patch (e.g. surface area, fractal dimension), connectivity of patch clusters, time since patch formation, and disturbance.

For each study area, we will create a patch level estimation of species diversity through field sampling of representative habitats found in each patch. A transect of five 100 m² quadrats, spaced 20 meters apart, is established within a single habitat type. Within each 100 m² quadrat, four 1 m² quadrats are established, allowing us to investigate the effect of grain size on the results. All woody species are counted and all herbaceous species are listed within the quadrats.

Although too few patches have been sampled at this point to test for correlations with the parameters, general comparisons of the species diversities of the four patches sampled can be made using species area curves. Cluster analysis has been performed in order to estimate the number of distinct communities present in the sampled areas. Preliminary results presented here are extracted from data collected in spring 1998.

Is the higher species diversity of the Adobe Dam flora largely due to a highly unique, diverse flora exclusively occupying this site and not the other

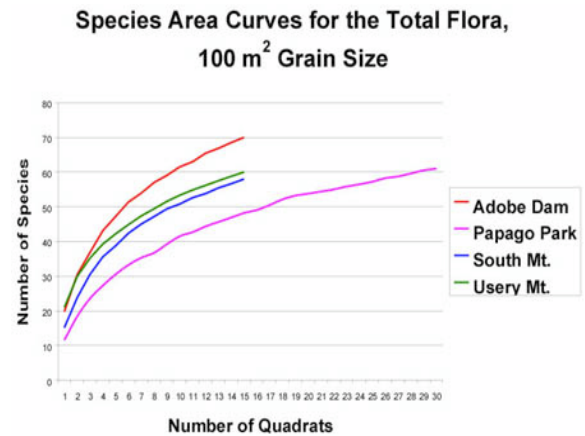


Figure 1. Adobe Dam Recreation Area has the highest species diversity of the patches sampled. Userly Mountain Park and South Mountain Park have intermediate diversities and Papago Park has the lowest. While Adobe Dam and Userly Mountain have comparable diversities at a small spatial scale (up to about 200 m²), Adobe Dam quickly surpasses Userly Mountain at higher spatial scales. This indicates a slightly more repetitive species distribution across Userly Mountain Park. (Click on figure to enlarge.)

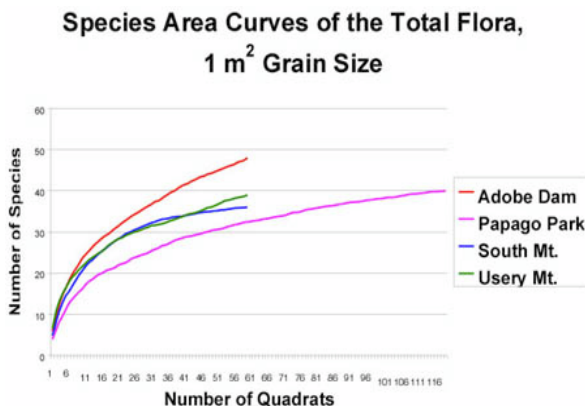


Figure 2. With a 1 m² grain size, the general pattern agrees with the curves generated using the 100 m² quadrat. However, all four sites have similar diversities at the 1 m² spatial scale,

three, or do the characteristics of this site allow for a mixture of species, both unique and shared, to thrive? In order to address this question, a simple, preliminary procedure was used. The percentage of species unique to a patch (not found in the other three patches) was calculated. The total flora, sampled with a 100 m² quadrat, and the woody species data sets were used. There is no test for significance; a qualitative comparison has been made. If the Adobe Dam community, or only the woody species component, is more unique than those associations found on the other three sites, then we would expect it to have substantially more unique species. If there is no appreciable difference, then the Adobe Dam associations are no more unique than the other three. An assumption is made in this procedure: differences in total area sampled will not affect the percentages.

Percentage of species unique to a patch:

	Total Flora	Woody Species
Adobe Dam	48	47
Papago Park	41	18
South Mountain	24	17
Usery Mountain	30	41

It is true that Adobe Dam has a higher proportion of unique species in both categories. However, the difference is slight and may not be significant. The question remains unresolved.

Cluster Analysis was used on the woody species data set to determine the nature of the communities present across the four study sites. This analytical method computes a dendrogram of samples based on similarity of the species composing the samples. Using the PC-ORD program, Version 3.0 for Windows (1997), we calculated the Sorensen distance between group means to determine the similarity between species lists of samples in order to obtain the dendrogram. It is up to the user to determine the level of resolution of groups. In this analysis, we were interested in broadly defined community types, listed below:

- 1. Saltbush dominated flats (Adobe Dam)
- 2. Lowland wash (Adobe Dam)
- 3. Lowland alluvial scrub (Adobe Dam)
- 4. Creosote dominated / mixed shrub (Papago Park)

which also diverge at larger scales. The smaller grain size will allow the herbaceous species to have more influence on the results. Since woody individuals usually occupy more space, they are less likely to be captured by the smaller quadrat. (Click on figure to enlarge.)

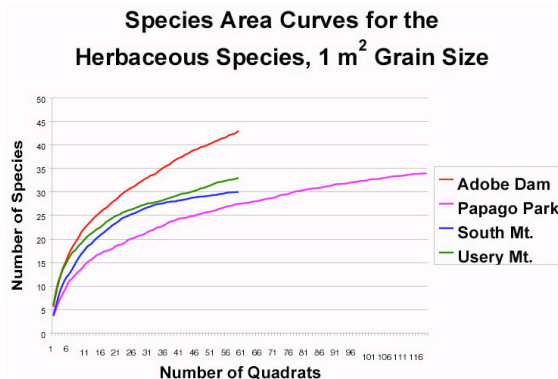


Figure 3. When only the herbaceous species are examined at the 1 m² grain size, the pattern is very similar to the pattern of the curves generated from the total flora sampled with a 1 m² quadrat. This result supports the concept mentioned in Figure 2: smaller grain sizes increases the influence of individuals occupying less space, the herbaceous species, on the results. (Click on figure to enlarge.)

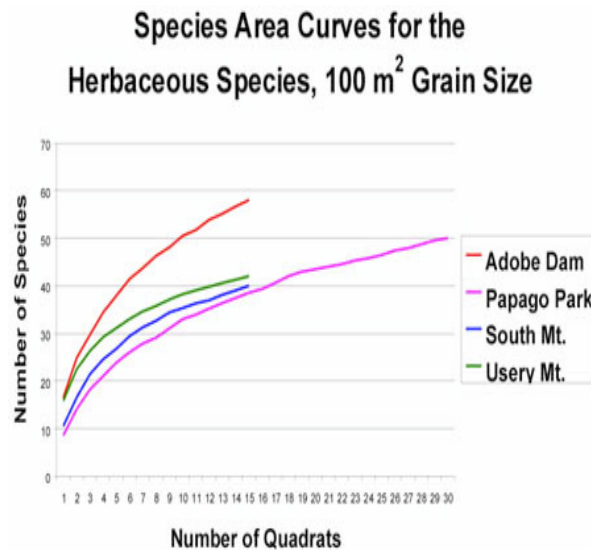


Figure 4. When the herbaceous species are sampled with the larger grain size of 100 m², a different pattern emerges. While Adobe Dam still has a substantially higher species diversity at larger spatial scales, the species area curves of South Mt. and Usery Mt. are much more similar to Papago Park's curve. (Click on figure to

- 5. Cacti / mixed shrub (South Mt., Usery Mt.) enlarge.)

These community designations apply to a spatial scale much larger than the grain size. Before running the analysis, we had expected to find a unique grouping of samples constituting an upland wash community, composed of genera such as *Lycium*, *Olneya*, and *Cercidium*. However, these samples did not cluster together and were spread throughout groupings 4 and 5. This may be a result of species not exclusive to the upland wash habitat (e.g. *Larrea tridentata*, *Ambrosia deltoidea*) occurring within or adjacent to this narrow, serpentine habitat.

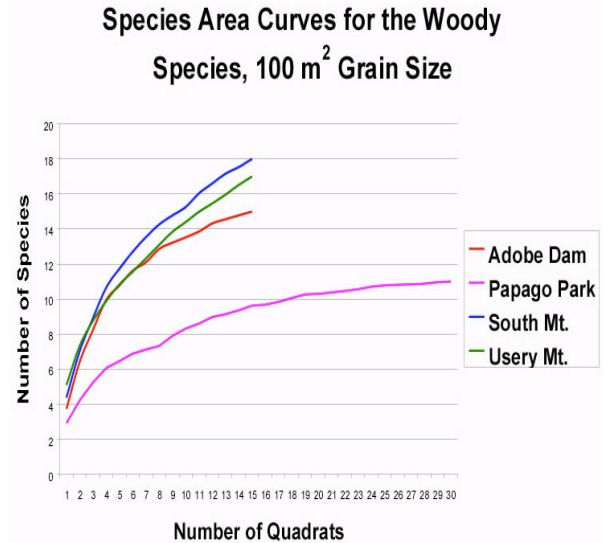


Figure 5. The curves for the woody species, sampled at a 100 m² grain size, show a pattern differing from the previous four graphs. Adobe Dam no longer has the highest diversity, which is now slightly lower than Usery Mt. and South Mt. This indicates that the higher diversity of the total Adobe Dam flora is due to a higher species diversity in the herbaceous than the woody component of the patch's plant communities. Another interesting feature of Figure 5 is the character of the Papago Park curve. At the terminus of the curve on the right side of the graph, the curve has almost flattened out. This indicates that at this large spatial scale, the curve has almost reached its azimuth value, which is the point at which no further species are collected regardless of an increase in sampled area. (Click on figure to enlarge.)