Effects of Land-Use on Pollen Frequency Distribution Patterns in the Phoenix Metropolitan Area

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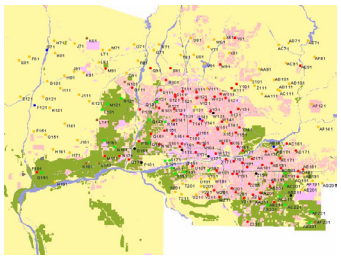


Map 1: CAP - LTER Sampling Locations, Phoenix Metropolitan Area.
Red = urban, yellow = desert, green = agriculture
brown = mixed, black = transportation, blue = water

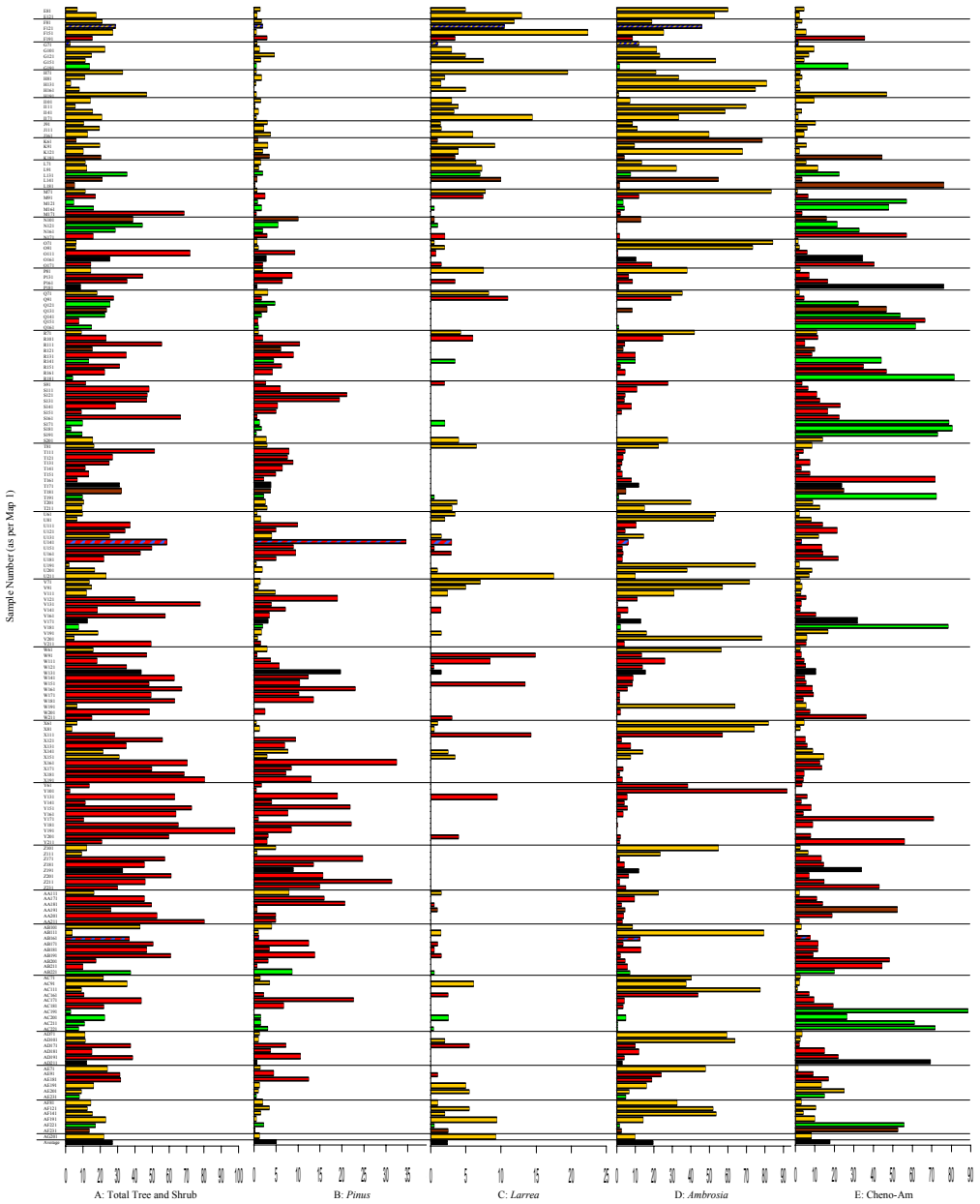
Pollen records derived from surface soil samples collected as part of the CAP – LTER sampling protocol (Map 1) reveal the effects that different land use practices are having on pollen frequency distribution patterns in the Phoenix metropolitan area. Some of the effects were anticipated. As can be readily observed by driving around or flying into the city, the metro area contains substantially more trees and shrubs than occur in the surrounding deserts and agricultural areas, and this is well reflected in tree and shrub pollen frequencies (Figure 1A). The simplest explanation for the even higher frequencies in the East Valley is the presence of a greater number of source plants, but the dynamics of pollen production, distribution, and deposition likely also play a role.

The increased frequency of tree pollen in urban settings is especially well illustrated by pine (*Pinus* sp.) pollen (Figure 1B). Pine trees produce a lot of pollen, as witnessed by seasonal yellow coatings on vehicles and swimming pools. Pine pollen is also widely disseminated, and is routinely recovered from Sonoran Desert surface pollen samples collected far from any source (see Schoenwetter and Doerschlag 1971). Given the widespread use of pine trees in urban landscaping in the Phoenix area, it was hypothesized that pine pollen frequencies would display a fairly uniform distribution across the metro area, and then gradually decline away from the city. However Figure 1B indicates that while pine pollen is fairly ubiquitous, it is certainly not uniformly distributed. Pine pollen frequencies drop rapidly away from urban land use areas; even those samples from desert remnants within the metro area contain relatively little pine pollen. And while generally occurring at high frequencies in urban samples, the distribution of urban pine pollen is by no means uniform. These variations lead to two tentative conclusions. First, while the sheer amount of pine pollen produced means that some will be widely disseminated the majority falls close enough to the source to produce readily discernable patterning, and second, that elevated frequencies of pine pollen are strongly correlated with urban, especially residential, land use.

Other taxa display clearer associations with desert environments. Figure 1C indicates that creosote-bush (*Larrea* sp.) pollen is most prevalent in the desert west of the city, but also occurs in desert samples from the north, south, and east of the city, as well as in those samples obtained from desert remnants within the metropolitan area. Urban samples that do contain appreciable quantities of creosote pollen tend to come from the margins of these desert areas. The near absence of creosote pollen from urban samples likely reflects removal of the plants from these locations, combined with its general lack of popularity as an ornamental shrub.

Ragweed and bur sage (*Ambrosia* sp.) pollen also tends to occur at higher frequencies in desert samples than those from urban or agricultural land use areas (Figure 1D), but differs from creosote in occurring in almost all urban samples, sometimes at quite high frequencies – *Ambrosia* pollen does tend to be much more widely disseminated than *Larrea* pollen. Urban locations at the edge of the city, or adjacent to desert remnants within the city, appear to be particularly prone to receiving relatively large influxes of this pollen. Ragweed pollen is one of the commonest causes of hay fever, and the LTER data suggest that while one can not totally escape this pollen, exposure can be limited by avoiding the desert – including the desert parks within the metro area – while *Ambrosia* may be in bloom (January – May).

Figure 1: Pollen Frequency Bar Charts for Total Tree and Shrub Pollen (A), *Pinus* (B), *Larrea* (C), *Ambrosia* (D), and Cheno-Am (E) pollen. Each curve expressed as a percent of the total pollen assemblage. The bars are color-coded as per Map 1.



Samples obtained from agricultural contexts tend to be palynologically distinct from urban or desert samples as they contain relatively very high frequencies of Cheno-Am pollen (Figure 1E). Cheno-Am refers to a morphologically similar group of pollen grains of the Chenopodiaceae and Amaranthaceae families. It encompasses a broad range of plants including a variety of weedy herbaceous plants encouraged by soil disturbance and salt enrichment common to agricultural fields and other human-disturbed areas (Cummings 1990, Fish 1994, Fish 1985). While some urban, transport, and mixed context samples also have high Cheno-Am values, these are all from areas adjacent to agricultural fields, with one sample (T161) from an industrial area as an exception. In general, it would appear that well maintained residential lots are poor places for members of this weedy group to become established.

While many of the pollen taxa identified from the LTER samples are present in too few samples or have frequencies too uniform to identify meaningful patterns through inspection of frequency data, a few of the taxa, including those presented here, display quite clear taxon – land use correlations. Additional research employing multivariate techniques will augment these frequency comparisons, and seek to better identify how variations in land-use structure the pollen record.

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