# Characterization of Microclimates in North Desert Village Sites


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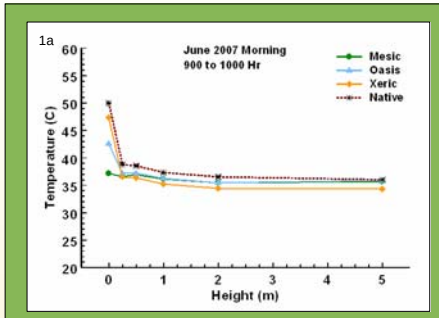
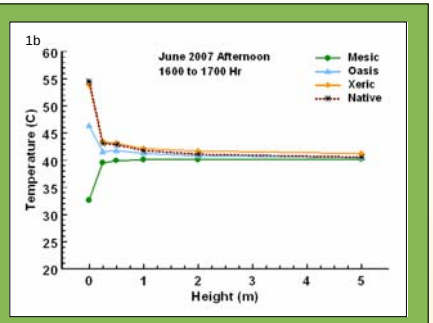
## Introduction

As the population of Phoenix continues to grow at a rapid pace, it becomes increasingly important to understand how landscape design effects urban heat islands at a neighborhood scale (Golden, 2004). The North Desert Village neighborhood experiment located on the ASU Polytechnic campus consists of four treatment sites. Each site consists of six single family residential units and their associated yards around a common landscaped area. The landscape design treatments are: mesic, which consists of extensive turf grass, high water use plants, and overhead sprinkler irrigation; oasis, which is a combination of drip irrigated high and low water use plants, and small patches of sprinkler irrigated turf; xeric, which has drip irrigated, desert adapted plants; and native, which has un-irrigated Sonoran Desert plants. Landscaped surfaces of the native, xeric and non-turf areas of the oasis treatments are covered with decomposing granite mulch. The purpose of this study was to examine the effects of landscape design on microclimate at the neighborhood scale before and during the North American summer monsoon.

## Methods

A suite of microclimate measurements were taken at 5.0 m increments along five transects in each of four study sites between 900-1000, 1600-1700 and 2100-2200 Hr on clear calm days during mid-June (pre monsoon) and late August (monsoon). These measurements included air temperature at heights of 5.0 m, 2.0 m, 1.0 m, 0.5 m and 0.25 m, as well as relative humidity at 2.0 m and surface temperature. Air temperatures were measured with shielded copper constantan thermocouples, except at 2.0 m where air temperature and relative humidity were measured by a shielded HMP45C-L probe. Surface temperatures were measured with an Apogee IRR-PN infrared radiometer.



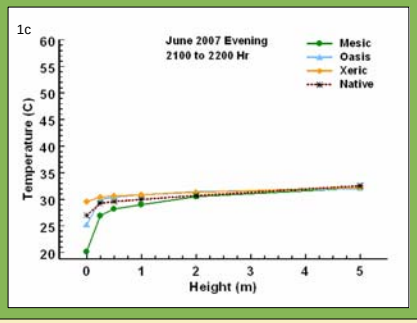
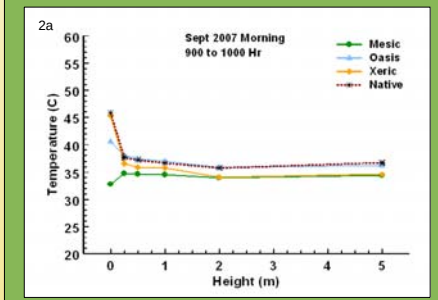
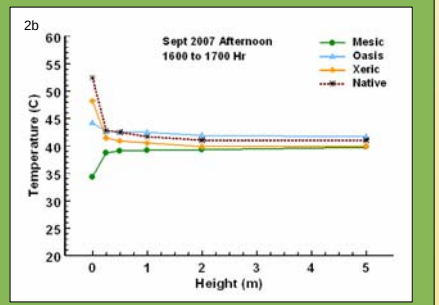




Figure 1. Effect of landscape design treatment on mean temperature profiles during a) morning, b) afternoon and c) evening of June 2007. Effects of landscape design on temperature profiles were most pronounced from surface to 2 m height. Mean surface temperatures were lowest in the mesic treatment. Mean surface temperatures were highest during morning and afternoon in xeric and native treatments. Landscape design affected surface temperatures most during afternoon (Fig. 1b).



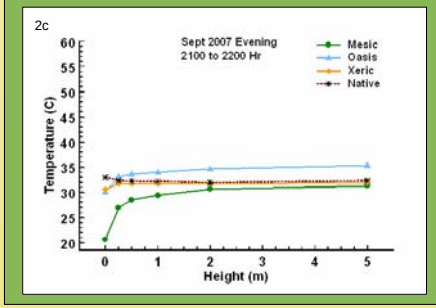




Figure 2. Effect of landscape design on mean temperature profiles during a) morning, b) afternoon, and c) evening of September 2007. Effect of landscape design on temperature profiles was most pronounced from surface to 2 m height. Overall, mean temperature patterns during June and September appeared similar suggesting negligible effect of summer monsoon conditions on microclimate conditions.

**Table 1.** Sample variance of mean air temperature of seven central transect points at 2.0 m above landscape surfaces.

***June 2007***

| | 9:00 AM | 4:00 PM | 9:00 PM |
|---|---|---|---|
| Mesic | 11.6[Z] | 16.5 | 3.3 |
| Oasis | 54.7 | 71. | 13.8 |
| Xeric | 26.9 | 29.4 | 2.1 |
| Native | 19.6 | 9.5 | 4.0 |

***September 2007***

| | 9:00 AM | 4:00 PM | 9:00 PM |
|---|---|---|---|
| Mesic | 11.9 | 13.2 | 2.2 |
| Oasis | 32.1 | 59.6 | 9.9 |
| Xeric | 19.4 | 48.2 | 0.7 |
| Native | 17.4 | 12.4 | 1.7 |

[Z] Sample variance = sum of squared deviations from the mean, divided by (N-N missing-1).

## Summary


Landscape design created microclimates on a residential neighborhood scale and differences were most pronounced between the surface and 2.0 m height. Within this height range microclimates were noticeably affected by surface cover types. Mesic landscape designs were generally cooler, likely because of increased evapotranspiration and latent heat transfer. Spatial variation (Table 1) was highest in the oasis landscape because of mixed cover types. Spatial variation (Table 1) was lowest during evening in all treatments. These data suggest that overall climate conditions of the summer monsoon in Phoenix do not have an appreciable effect on residential neighborhood landscape climates.


## References


Golden, J. 2004. The built environment induced urban heat island effect in rapidly urbanizing arid regions—A sustainable urban engineering complexity. Env. Sci. 4:321-349.



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