Supplement Request

CAP LTER: Land-Use Change and Ecological Processes in an Urban Ecosystem of the Sonoran Desert (DEB-9714833)

Nancy B. Grimm and Charles L. Redman, PI/PDs

The creation of urban LTER projects in 1997, and the augmentation of two extant LTER sites in the early 1990's, introduced new opportunities and challenges to ecology, and catalyzed a new respect for and interest in study of human-controlled ecosystems (e.g., see (Daily 2003). The Central Arizona-Phoenix LTER has been at the forefront of developing a conceptual framework (Grimm et al. 2000, Wu and David 2002) and testing out new experimental and sampling approaches (Hope et al. 2003) to unravel the complexity of the most human-dominated of all ecosystems, the urban ecosystem. Understanding ecological processes that occur in this heterogeneous and dynamic ecosystem requires new insights and fresh perspectives that are able to encompass the interaction of ecological and social systems. Furthermore, our study site exists as an ever-changing, heterogeneous mosaic of land-use patches tied together by social institutions, highways, and energy-distribution systems and shared with >3 million people who call it home. These features have forced us to consider new ways of conducting our science. Among the new approaches we have taken, a most promising opportunity has arisen that will permit quasi-controlled, experimental manipulation of individual home lots to determine the long-term effects of different management regimes, initial biodiversity characteristics, and individual human behavior on several important ecological processes and state variables. The supplement we request here will allow us to expand the original design (establishment of which is supported, in part, by this year's general supplement), incorporate climate research at two scales, and explore the possibility of expanding this design to an Albuquerque planned development by collaborating with Sevilleta LTER scientists.

The objectives of this expanded work are:

1. To add a native vegetation treatment to the planned xeriscape, oasis, and mesiscape treatments
2. To study effects of landscape design and management on microclimate, compared to a larger-scale backdrop of urban fringe climate established with a new weather station
3. To collaborate with UNM (SEV) ecologists in designing a parallel experiment for a large planned housing development to be built south of Albuquerque

"SUBURBOSPHERE" EXPERIMENTAL RESIDENTIAL YARD DESIGN

A unique opportunity has been afforded us by the creation of ASU's new East Campus. Residential properties are being renovated by the university, and we have secured agreement with Physical Facilities management to define and design landscapes on individual properties. Our 2003 General Supplement proposal outlined in detail our original experimental design, which is summarized briefly here. Three residential landscape design/water delivery types (mesic/flood, oasis/mixed, and xeric/drip) established in blocks of 6 replicates (mini-neighborhoods) will recreate the three most prevailing residential yardscapes types found across the CAP study area during the last five years of research (Martin et al. 2003). The mesic design/flood type will consist of a mixture of exotic "high water use" vegetation and turfgrass that is irrigated by flood irrigation technology. The oasis design/mixed type will consist of a mixture of drip-irrigated, "high" and "low" water use plants and sprinkler-irrigated turfgrass. The xeric design/drip type will consist of drip-irrigated, "low water use" plants without turf grass. The additional yards in this development (which are shortly to be converted to "zeroscape" i.e. gravel with no plants, by ASU facilities management) will serve as buffers and controls around the CAP experimental homes.

Objective 1: To this 3-treatment design we propose to add a fourth treatment, native desert landscape, which will feature native vegetation and minimal watering. In the several months of discussion leading up to this opportunity for additional funds, a core group working on the design of the North Desert Village (NDV) "suburbosphere" has concluded that this treatment is absolutely essential, as herbivores, pollinators, and other consumers have been shown to respond strongly to native vegetation (McIntyre and Hostetler 2001, McIntyre et al. 2001). This request therefore would cover the additional cost of purchasing native plants to stock six additional properties, forming a fourth treatment. Plants to be used include *Larrea tridentata*, *Ambrosia deltoidea*, *Cercidium microphyllum*, *Olneya tesota,* and *C. floridium.* The per-yard costs of this treatment will be substantially lower than for the other treatments.

Objective 2: Determine the effects of planting and watering regimes on microclimate. We will install micrometeorological stations that cover each of the four mini-neighborhoods (blocked planting-water regime treatments). Climate monitoring at the NDV "suburbosphere" will be done at the mini-neighborhood scale, but can be referred to both local and regional scales using an existing climate monitoring network, supplemented with a new local base station established at ASU East with separate funding. This completely automated surface weather station will be used in two ways: (a) to assess the rapidly changing climate conditions of the rural landscape at ASU East as development takes place from the urban fringe to the west of ASU East (tracking impending urbanization effects), and (b) as a "control" site for comparison with in-neighborhood landscape microclimate sampling. Measurements will include a standard array of temperature, humidity, and wind data in addition to incoming solar radiation, PAR, UVB, net radiation, and subsurface heat flux, moisture, and temperature. This urban fringe base station will provide data that can be analyzed in the context of the network of climate monitoring stations already in place in the Phoenix metropolitan area.

We propose to set up microclimatological monitoring at the four mini-neighborhoods, using the requested supplemental funds. To establish the variability of surface conditions linked to regional weather, we will monitor air temperature, wind speed, relative humidity, surface reflected radiation, net radiation, soil moisture at 30 and 100 cm depth, soil temperature at 0, 30 and 100 cm depth, and precipitation. Data loggers at each site will record this information.

Objective 3: Initiate cross-site comparison (planning) with UNM (Sevilleta) scientists to propose a parallel experiment in a new Albuquerque, NM development. A master planned development that is touted as conservation-minded, sustainable, and transit-oriented mixed-income community is slated to be built within the city limits of Albuquerque within the next 5 years. The plan also features a significant research component. Scott Collins (SEV LTER) has been asked to join the planning group for the 12,4000-acre development, representing ecological science. Given our experience with urban ecology, we request funds to support travel (by UNM scientists to our site, and by ASU scientists to NM) to establish a working relationship with the planning group and enter into an exchange of ideas about experimental design and research results. At this point it seems fruitful to plan a parallel experiment for Mesa del Sol neighborhoods, given that landscapes in this semi-arid environment are likely to follow similar patterns as in Phoenix (i.e., mesiscape and xeriscape, with significant use of non-native species). Our request is simply for travel moneys to support this exchange; we anticipate a larger cross-site proposal if our efforts are successful.

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