Central Arizona - Phoenix Long-Term Ecological Research (CAP LTER)

Fifth Annual Poster Symposium

Wednesday, February 19, 2003
Arizona Room, Memorial Union
Arizona State University

Sponsored by:
Center for Environmental Studies
Arizona State University

Central Arizona – Phoenix Long-Term Ecological Research (CAP LTER)

Fifth Annual Poster Symposium Agenda
Wednesday, February 19, 2003
Arizona Room, Memorial Union

10:00-1:00	Posters will be available for viewing
1:00-1:15	Welcome and Introductions
1:15-2:15	Keynote Address – **Carole Crumley**, ***Historical Ecology: Forging an Integrated Architecture.***
2:15-3:15	Social with refreshments
3:15-3:30	Poster Session #1
3:30-4:30	Poster Session #2
5:30-	All are invited to an informal gathering at Bandersnatch, a brew pub located in downtown Tempe at 125 E 5th Street.

CAROLE CRUMLEY

Carole L. Crumley is a Professor of Anthropology at the University of North Carolina at Chapel Hill. She received her Ph.D. in 1972 at the University of Wisconsin. Professor Crumley's research interests include historical ecology, state societies, complex systems theory, global environmental change, ethnography, ethnohistory, and archaeology of Europe. Her doctoral work and subsequent research has reflected a keen interest in state-level societies and in macro-scale spatial configurations and their relationships to socio-political organization. Professor Crumley studies the historical ecology of Burgundy, France, from before the Roman Conquest to the present. She works extensively on exploring the role of gardens in the transmission of cultural knowledge. Current research seeks to identify and document social, political, and economic elements of land-use practices together with historical and environmental circumstance that combine to sustain a productive regional economy over the long term (centuries). Professor Crumley is a member of the Executive Steering Committee, Past Global Changes Core Project of the International Geosphere-Biosphere Program, the Vice Chair of the U.S. Committee of the International Union of Anthropological and Ethnological Sciences and in leading positions in other Committees and Programs.
(http://www.unc.edu/depts/anthro/faculty/fac_pages/crumley.html)

2003 CAP LTER Symposium

Poster Session #1 (23)	Poster Session #2 (20)
Baker, Westerhoff, and Sommerfeld	Anderson, Fernando, Hyde, Redman, and Xin
Butler, Whitcomb, and Stutz	Bolin, Smith, Hackett, Grineski, Collins, Vuppaladadium, and Kronenfeld
Celestian and Martin	Elliott, Gade, Schaafsma, Crider, Meegan, and Swanson
Elser and Saltz	Gonzales and Allen
Hope and Gries	Goodman
Hu, Fortuna, Sommerfeld, and Westerhoff	Gries, Prasad, and Zisner
Ivanich, Tyburczy, Arrowsmith, and Diaz	Grossman-Clarke, Hope, Lee, Fernando, Hyde, Stefanov, and Grimm
Jenerette and Wu	Grossman-Clarke, Zehnder, and Stefanov
Klett, Lord, and Lundgren	Harlan, Bolin, Hackett, Hope, Kirby, Larsen, Nelson, Rex, Wolf, and Jones
Katti and McCartney	Hope, Grossman-Clarke, Lee, Fernando, Hyde, Stefanov, and Grimm
Lewis, Stabler and Martin	Jones, Brazel, Eisinger, Harlan, Hedquist, Grineski, Jenerette, Larsen, Lord, Parker, Preshad, Selover, Stefanov, and Zeigler
Mahkee and Martin	Katti, Shochat, and Anderies
Marussich and Faeth	Kaye, Brazel, Netzband, and Katti
McCulley and Kaye	Martin, Warren, and Kinzig
Musacchio	McCartney, Gries, Schoeninger, Sundermier, and Gilbert
Netzband and Stefanov	Perry, Anderson, and Busek
Roach and Grimm	Roberts, Koneya, Burnett, Walton, Worley, and Bagley
Ross, Jennings, Putnam, Small, and Deviche	Stabler and Martin
Stefanov	Swanson, Crider, Meegan, Elliott, Gade, and Schaafsma
Stuart, Katti, and Turner	Warren, Kinzig, Cox, Grove, Martin, and Nilon
Whitcomb and Stutz	
Whitcomb and Stutz	

LIST OF POSTERS

POSTER SESSION #1

CAP LTER CORE MONITORING

Hope, Diane, and Corinna Gries. Core monitoring for CAPII - an interactive virtual poster display. (Separate display with computer and LCD projector).

ECOLOGICAL SURVEYS AND EXPERIMENTS

Butler, Lane, Sean Whitcomb, and Jean Stutz. Small-scale spatial patterns of arbuscular mycorrhizal fungal infectivity in an experimental urban landscaped site.

Elser, Monica, and Charlene Saltz. K-12 Student contributions to the CAP LTER Project.

Jenerette, G. Darrel, and Jianguo Wu. Multiple-scale spatial variation of terrestrial ecosystems in an urbanized desert environment.

Lewis, David B., Linda B. Stabler, and Chris A. Martin. Ecological stoichiometry of horticulture: Consequences of pruning and irrigation for plant and soil chemistry.

Mahkee, Darin K., and Chris A. Martin. Leaf morphology of four landscape taxa in response to irrigation volume and pruning frequency.

Marussich, Wendy A., and Stanley H. Faeth. Comparing trophic dynamics in urban and desert ecosystems using arthropod communities on brittlebush (*Encelia farinosa*).

McCulley, Rebecca, and Jason Kaye. Soil microbial communities in urban ecosystems compared to nearby native grasslands and agriculture.

Ross, Matthew S., David Jennings, Christopher Putnam, Thomas Small, and Pierre Deviche. Home range sizes of Cactus Wrens (*Campylorhynchus brunneicapillus*) at Arizona State University.

Stuart, Diana, Madhusudan Katti, and Will R. Turner. The r(iparian) factor: A comparison of Phoenix and Tucson avifauna.

Whitcomb, Sean, and Jean Stutz. Small-scale spatial patterns of arbuscular mycorrhizal fungal diversity in an experimental urban landscaped site.

Whitcomb, Sean, and Jean Stutz. Pruning effects on root length density, root biomass, and arbuscular mycorrhizal colonization in two shrubs in a simulated xeric landscaped yard.

LAND USE AND LANDSCAPE: ASSESSMENT AND INFLUENCE ON SPATIAL DISTRIBUTIONS

Celestian, Sarah B., and Chris A. Martin. Urban land use and surface cover: Effects on soil temperatures.

Katti, Madhusudan, and Peter McCartney. The distribution of bird species diversity in the Phoenix metro area: Visualizing the spatial patterns of diversity in an expanding urban matrix.

Klett, Mark, Matthew Alan Lord, and Michael Lundgren. A rephotographic survey of landscape change and persistence for the Greater Phoenix 2100 project.

Netzband, Maik, and William L. Stefanov. Remote sensing and landscape metrics for global ecological monitoring.

Stefanov, William L. Assessment of landscape fragmentation associated with urban centers using ASTER data.

WATER MANAGEMENT AND WATER QUALITY

Baker, Lawrence A., Paul Westerhoff, and Milton Sommerfeld. Management strategy to reduce tastes and odors in Phoenix's water supply.

Fortuna, Alan, Qiang Hu, Milton Sommerfeld, and Paul Westerhoff. Physiologial studies of MIB- and geosmin-producing cyanobacteria isolated from the Phoenix drinking water supply system.

Ivanich, Paul A., James A. Tyburczy, J Ramón Arrowsmith, and Mimi Diaz. Measuring bedrock topography using gravity to understand subsidence along a portion of the CAP canal in northeast Scottsdale.

Musacchio, Laura. Landscape ecological classification and analysis of a 100-year floodplain corridor in the Phoenix metropolitan region.

Roach, W. John, and Nancy B. Grimm. Nutrient cycling along an urban desert lake chain: The effects of anthropogenic modifications of Indian Bend Wash.

POSTER SESSION #2

CAP LTER DATA/INFORMATION MANAGEMENT

Gries, Corinna, Shalini Prasad and Cindy Zisner. A virtual tour of CAP LTER.

McCartney, Peter, Corinna Gries, Robin Schoeninger, Amy Sundermier, and Edward Gilbert. The Southwest Environmental Information Network.

ENVIRONMENTAL AND SOCIOECONOMIC INTERACTION

Bolin, Bob, Scott Smith, Ed Hackett, Sara Grineski, Tim Collins, Deepa Vuppaladadium, and Jennie Kronenfeld. Toxic tracts: A historical geography of environmental inequality in Phoenix, Arizona.

Goodman, Victoria. Time of transition: The effects of change in hunter-gatherer societies.

Harlan, Sharon, Tom Rex, Larissa Larsen, Edward Hackett, Andrew Kirby, Shapard Wolf, Amy Nelson, Robert Bolin, Diane Hope, and Nancy Jones. Community and environment in a desert metropolis.

Jones, Nancy, Anthony Brazel, Christopher Eisinger, Sharon Harlan, Brent Hedquist, Sara Grineski, Darrel Jenerette, Larissa Larsen, Matthew Alan Lord, John Parker, Lela Preshad, William L. Stefanov, and Danielle Zeigler. Neighborhood ecosystems: Human-vegetation-climate interactions in a desert metropolis.

Katti, Madhusudan, Eyal Shochat, and J. Marty Anderies. Living in the city: Resources, predation, foraging behavior, and population dynamics.

Martin, Chris A., Paige Warren, and Ann Kinzig. Landscape vegetation in small urban parks and surrounding neighborhoods: Are socioeconomic characteristics a useful predictor of vegetation taxa richness and abundance?

Roberts, Mark, Mele Koneya, Peter Burnett, Rita Walton, Don Worley, and Anubhav Bagley. Land use and socioeconomic modeling at MAG.

Schaafsma, Hoski, Kris Gade, Michelle Elliott, Destiny Crider, Cathryn Meegan, and Steve Swanson. Investigating environmental and social heterogeneity in a landscape perspective: A Hohokam case study.

Stabler, Linda B., and Chris A. Martin. Carbon and water relations of *Nerium oleander* in simulated urban landscapes.

Swanson, Steve, Destiny Crider, Cathryn Meegan, Michelle Elliott, Kris Gade, and Hoski Schaafsma. Long-term cultural and ecological responses to changes in climate in central Arizona AD 900-AD 1200.

Warren, Paige S., Ann P. Kinzig, Mary Cox, J. Morgan Grove, Chris Martin, and Charles Nilon. Human socioeconomic factors and avian diversity: A cross-site comparison.

LOCAL CLIMATE AND ATMOSPHERIC DEPOSITION

Anderson, James, H. Joe S. Fernando, Peter Hyde, Raymond Redman, and Hua Xin. Temporal patterns of "Unhealthy" to "Hazardous" concentration maxima for coarse particles (PM10) in southwest Phoenix during typical low wind speed connections.

Gonzales, Daniel A., and Jonathan O. Allen. Aerosol nutrient deposition measured by eddy-correlation mass spectrometry.

Grossman-Clarke, Susanne, Diane Hope, Sang-Mi Lee, H. Joe S. Fernando, Peter G. Hyde, William L. Stefanov, and Nancy B. Grimm. Modeling temporal and spatial characteristics of nitrogen dry deposition in the Phoenix metropolitan area.

Grossman-Clarke, Susanne, Joseph A. Zehnder, and William L. Stefanov. Effects of urban land cover modifications in a mesoscale meteorological model on surface temperature and heat fluxes in the Phoenix metropolitan area.

Hope, Diane, Susanne Grossman-Clarke, Sang-Mi Lee, H. Joe S. Fernando, Peter G. Hyde, William L. Stefanov, and Nancy B. Grimm. The importance of dry deposition to the nitrogen mass balance of an arid urban ecosystem.

Kaye, Margot, Anthony Brazel, Maik Netzband, and Madhusudan Katti. Perspectives on a decade of climate in the CAP LTER region.

Perry, Dana, James Anderson, and Peter R. Busek. Analysis of atmospheric particles deposited onto mesquite leaves in the Central Arizona - Phoenix LTER area.

ABSTRACTS

All of the following abstracts are listed alphabetically by first author.

Anderson, James[1], H. Joe S. Fernando$_1$, Peter Hyde[2], Raymond Redman[2], and Hua Xin[1]. ***Temporal patterns of "Unhealthy" to "Hazardous" concentration maxima for coarse particulates (PM10) in southwest Phoenix during typical low wind speed conditions.*** [1]Environmental Fluid Dynamics Program, Arizona State University, Box 876101, Tempe, AZ 85287-6106; and [2]Arizona Department of Environmental Quality, Phoenix, AZ.

The Maricopa County airshed that includes the greater Phoenix urban area is in noncompliance with regard to the daily and yearly National Ambient Air Quality Standards (USEPA) for particulate matter 10 m and smaller in diameter (PM10). The most serious PM10 problem is in a part of southwest Phoenix known as the Salt River Industrial Area. Normal monitoring of PM10 deals with daily and yearly averages. If the PM10 concentration was relatively uniform over each day, the area's reported highest concentrations would be considered "Moderate" to "Unhealthy for Sensitive Groups" when translated to the EPA's Air Quality Index. However, recent PM10 measurements in the Salt River Industrial Area have shown that when considered on an hourly or shorter basis, there is a repeated pattern of peak concentrations in the morning and sometimes in the late afternoon or evening that would be classified as "Unhealthy" (255-354 g per cubic meter of air), "Very Unhealthy" (355-424) or even "Hazardous" (425+). For all animals with lungs (including humans), the consequences of exposure to breathing these very high concentrations even for short periods may be very different than to breathing PM10 levels that stay near the 24-hour averages. The coincidence of many particle sources with a topographic feature that controls the wind patterns is responsible, plus the low wind speeds for which the Phoenix urban area is noted. A large array of industrial operations that produce particulates, sand and gravel mining operations, major freeways (parts of I-10 and I-17), and some heavily traveled but inadequately paved roads are within or roughly parallel to the Salt River channel. The highest PM10 concentrations occur near the daily times of lowest wind speed, the transition periods when wind direction reverses after the sun sets or rises. PM10 builds up during the transition periods, and then the air masses are slowly advected down (cooling of surface at night) or up (heating of surface in day) the valley. The very highest PM10 concentrations coincide with the morning rush hour.

Baker, Lawrence A.[1], Paul Westherhoff[2], and Milton Sommerfeld[3]. ***Management strategy to reduce tastes and odors in Phoenix's water supply.*** [1]Water Resources Center, University of Minnesota, 173 McNeil Hall, 1985 Buford Avenue St. Paul, MN 55108; [2]Department of Civil and Environmental Engineering, Arizona State University, Box 875306, Tempe, AZ 85287-5306; and [3]Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

Municipal drinking water in the Phoenix area often has "musty" and "moldy" tastes and odors (T&O) caused primarily by certain blue-green algae in the water supply system. In 1999, we started a collaborative project with the City of Phoenix to develop a comprehensive T&O reduction strategy. The project was built upon the concept of "multiple barriers" where T&O control measures could be implemented.

The three-year project included a major sampling program (20 or more sites located throughout the water delivery system, sampled monthly to weekly), lab experiments to improve treatment techniques and learn more about the dynamics of T&O compounds, isolation and identification of specific T&O producing algae, and field-scale experiments to evaluate specific treatments.

Some successful "barriers" that were developed include: (1) selective withdrawal from Lake Pleasant, (2) canal treatments to remove T&O-producers at "hotspots" along canals, (3) source switching (switching water production among plants to avoid T&O episodes), and (4) use of powdered activated carbon (PAC) to adsorb T&O compounds within treatment plants. An electronically distributed "T&O Newsletter" was developed to provide a constant flow of new data, treatment recommendations, and research updates to about 80 individuals in the water treatment community.

During the first year of implementation (2001), the T&O management program reduced the number of "consumer days below threshold" (a measure of water delivered to customers with little or no T&O) by one-third to one-half. During 2002, the T&O problem was reduced even further (data analysis underway). The multiple barrier strategy, with ongoing monitoring, is far less expensive than the alternative of treating the problem solely within the water treatment plants. In summary, this project provided proof-of-concept for a regional approach for water quality management and is an excellent example of collaboration between academia and the community to accomplish environmental goals.

Bolin, Bob[1], Scott Smith[2], Ed Hackett[1], Sara Grineski[1], Tim Collins[2], Deepa Vuppaladadium[3], and Jennie Kronenfeld[1]. ***Toxic tracts: A historical geography of environmental inequality in Phoenix, Arizona.*** [1]Department of Sociology, Arizona State University, Box 872101, Tempe AZ 85287-2101; [2]Department of Geography, Arizona State University, Box 870104, Tempe AZ 85287-0104; and [3]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211.

In this research we examined the development of environmental inequalities in the Phoenix, Arizona metropolitan area. Based on late 1990s locations of toxic release inventory facilities, large-quantity generators of hazardous waste, treatment, storage and disposal facilities, and toxic contamination sites, high hazard areas in the Phoenix metro area were identified. Using current patterns of environmental inequalities, case studies were developed that traced the development of contaminated neighborhoods within the city over a period of more than a century. Our focus has been on identifying historical-geographic changes in land uses, demographic composition of neighborhoods and the siting/abandonment of hazardous industrial facilities that have eventuated in pronounced environmental inequities by race and class in Phoenix. We examined a complex of social, political, and economic factors operating at different spatial scales that, over time, have produced inequities in the distribution of industrial hazards and contamination sites. A chief element in the evolution of environmental injustice in Phoenix has been the persistent sociospatial effects of racial segregation, industrial concentration, and transportation corridors. How those three phenomena are imbricated with subsequent development patterns engendered by rapid postwar suburbanization, urban redevelopment, and industrial decentralization were examined. Detailed historical geographies of areas with high hazard loads were used to illustrate these processes. The research concludes with a discussion of environmental inequalities in relation to patterns of uneven geographic development and urban planning issues in the Phoenix metropolitan area.

Butler, Lane, Sean Whitcomb, and Jean Stutz. ***Small-scale spatial patterns of arbuscular mycorrhizal fungal infectivity in an experimental urban landscaped site.*** Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

Small-scale spatial patterns of abundance of arbuscular mycorrhizal fungal (AMF) propagules in soil are often non-random. Propagules may be more abundant in the immediate vicinity of plants than in areas of bare soil. In this study, AMF infectivity in two, 9.2 m-x-9.2-m cultivated test plots at the Phoenix Desert Botanical Garden was determined as a measure of AMF propagule abundance. These plots were established via removal of native vegetation, discing of soil and planting of oleander (*Nerium oleander*), Texas sage (*Leucophyllum frutescens*), eucalyptus (*Eucalyptus microtheca*), Virginia oak (*Quercus virginiana*), fairyduster (*Calliandra eriophylla*),

purple prickly pear (*Opuntia violacea*), and rosemary (*Rosmarinus officinalis*). Soil samples were taken at 25 points in each plot in a regular grid pattern and planted with sudangrass (*Sorghum bicolor*) to establish infectivity bioassays. After 6 weeks roots from the bioassays were extracted, cleared of their cell contents, and stained for detection of AMF infection. Infectivity at each sample point was quantified by microscopic analysis. Preliminary results suggest that infectivity is higher around plants than in bare areas. Spatial statistics will be used to further assess these results.

Celestian, Sarah B., and Chris A. Martin. ***Urban land use and surface cover: Effects on soil temperatures***. Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ, 86287-1601.

Spatial and temporal patterns of soil temperatures within 30 cm of the ground surface heavily influence biological processes such as terrestrial plant root growth, transfer of water and nutrients from soil to roots, and microbial activity. Urban systems have a mixture of heterogeneous surface cover types ranging from asphalt and concrete to turf. These surface cover types are often associated with human land use and might have differing effects on patterns of soil temperatures. During 35 days of summer 2002, we recorded diel amplitudes and patterns of soil temperatures, 30 cm below the ground surface at four metropolitan Phoenix urban land use sites and associated surface cover types: 1) commercial parking lot medians surrounded by asphalt, 2) mesic landscape with turf surface cover, 3) xeric landscape with inorganic surface cover, and 4) remnant Sonoran Desert. Temperatures were measured using either copper constant thermocouples attached to a micrologger or portable data loggers. Temperatures were recorded hourly and mean daily temperatures for each hour were reported. We found that the remnant desert site had the highest mean soil temperature (38.3°C). The xeric site had the highest mean amplitude (2.9°C). The mesic site had the lowest mean maximum soil temperature (27.2°C) and diel amplitude (0.3°C). Highest soil temperatures were recorded around midnight and the lowest soil temperatures were recorded around noon at all land use sites except the mesic site. These results indicate that differing surface cover types have an effect on the spatial and temporal patterns of soil temperatures.

Crumley, Carole, Keynote Speaker. ***Historical ecology: Forging an integrated architecture***. Anthropology Department, 301 Alumni Building, CB 3115, University of North Carolina, Chapel Hill, Chapel Hill, NC 27599-3115.

Historical ecology explores complex chains of mutual causation in human-environment relations, drawing on concepts from the biological and physical sciences and ecology, and from social sciences and humanities disciplines. The

practice of historical ecology draws a picture of human-environment relations over time in a particular place, through the integration of evidence from many disciplines. Researchers in historical ecology presume multiple cause-and-effect relationships, develop an interdisciplinary grammar and rules for treating diverse evidentiary categories, and relate scientific and institutional goals to public awareness and participation.

Focusing on the unique characteristics of place, historical ecologists gather environmental and cultural evidence for the region in question, explore the range of current practices likely to be impacted by environmental change, search for culturally sensitive and regionally appropriate adaptive strategies, and suggest the means by which such adaptations might be fostered through policy.

Elser, Monica, and Charlene Saltz. ***K-12 student contributions to the CAP LTER project.*** Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211.

Students from across the Phoenix metropolitan area have been involved in collecting CAP LTER population data in their schoolyards. The Ecology Explorers program has several components that make this a successful scientist-teacher-student partnership.

Fortuna, Alan [1], Qiang Hu[1], Milton Sommerfeld[1], and Paul Westerhoff[2]. ***Physiological studies of MIB- and geosmin-producing cyanobacteria isolated from the Phoenix drinking water supply system.*** [1]Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601; and [2]Department of Civil and Environmental Engineering, Arizona State University, Box 875306, Tempe, AZ 85287-5306.

Musty/earthy tastes and odors (off-flavors) occurring in the Phoenix drinking water supply system during the summer and fall seasons have been attributed mainly to two metabolites, 2-methyl-isoborneol (MIB) and geosmin. Cyanobacteria (or blue-green algae) were implicated as the culprit organisms responsible for these metabolites. Two benthic filamentous cyanobacteria, *Pseudanabaena* sp. and *Oscillatoria* sp. were isolated from the Phoenix drinking water distribution system and confirmed to be MIB- and geosmin-producers, respectively. Effects of temperature and light intensity on population proliferation, and production and release of MIB and geosmin by these two organisms were studied under laboratory conditions. Cell autolysis and release of MIB and geosmin were also investigated under dark conditions. Onset of cell autolysis and concomitant decrease in cell-bound MIB in *Pseudanabaena* sp. occurred shortly after the cells were transferred into the dark, followed by a gradual increase in MIB concentration in the growth medium. In the case of *Oscillatoria* sp. the cellular response to dark

incubation was slightly different. Limited autolysis occurred in the dark during the first week, followed thereafter by subsequent rapid autolysis and a rapid increase in geosmin concentration in the growth medium. Understanding the basic physiological responses of these MIB- and geosmin-producers to environmental factors is critical for development of effective field control measures to reduce or eliminate the off-flavors in the Phoenix drinking water supply system and also to be able to predict when off-flavor episodes are likely to occur.

Gonzales, Daniel A., and Jonathan O. Allen. ***Aerosol nutrient deposition measured by eddy-correlation mass spectrometry.*** Department of Chemical and Materials Engineering, Arizona State University, Box 876006, Tempe, AZ 85287-6006.

Dry deposition of aerosols contributes to the nutrient loading of urban ecosystems and surrounding areas. Gaseous nitrogen species include oxides (NO_X) from vehicle emissions and other combustion processes, which react with ammonia (NH_3) from agricultural activities to form ammonium-nitrate aerosols. Estimates of nitrogen dry deposition in Phoenix (6.7-18 kg $ha^{-1}y^{-1}$) are uncertain and improved estimates are a key goal of the CAP LTER biogeochemical research program. The eddy-correlation technique has been used to quantify the flux of aerosol particles measured by the Aerodyne Aerosol Mass Spectrometer (AMS). Using the AMS, particle size is measured in a time-of-flight chamber and chemical composition is determined by a quadrupole mass spectrometer. Co-located with the AMS inlet is a sonic anemometer to measure wind velocity and direction. The eddy-correlation method is used to calculate the flux of aerosol particles as the covariance of the vertical wind velocity and the species concentration, both measured at 10 Hz. Aerosol flux results from the PROPHET 2001 study are presented. Future plans for a field study in the Phoenix area include collaboration with ecologists and soil biologists to estimate nitrogen dry deposition and soil response.

Goodman, Victoria. ***Time of transition: The effects of change in hunter-gatherer societies.*** Department of Anthropology, Arizona State University, Box 872402, Tempe, AZ 85287-2402.

The biggest challenge contemporary hunter-gatherers face today is the ongoing pressure concerning the transition to a more sedentary lifestyle that incorporates the cultural dimensions of agriculture and/or pastoralism into their lifeways. Both the direct effects of local government programs and the indirect effects posed by changes to the environment that have been brought on as a result of herders and growers entering an area puts strain on the traditional ways hunter-gatherers have survived in the past. To many of today's hunter-gatherers where agriculture and the corresponding sedentism that ensues are still a recently incorporated concept, an

interesting balance between the two is beginning to emerge and a new trend that blends the old ways with the new is taking shape. My argument is that the social and economic implications attached to the subsistence activities surrounding lifeways involving primarily hunting and gathering are so great that a transition into a more sedentary lifestyle through the incorporation of agriculture and/or pastoralism may be a very difficult transition for hunter-gatherer cultures to adopt. I believe that by examining the variables that influence such changes (including the incorporation of such concepts as ownership and social stratification) it may be possible to determine at what point full time sedentary living is readily accepted, at what point it becomes necessary, and at what point it becomes irreversible. Finally, I believe that through the analysis of the aforementioned data information may be extrapolated to hopefully make some relevant predictions as to the future of today's hunter-gatherers.

Gries, Corinna[1], Shalini Prasad[1,2], and Cindy D. Zisner[1]. ***A virtual tour of CAP LTER***. [1]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; and [2]School of Design, CAED, Arizona State University, Box 2105, Tempe, AZ 85287-2105.

A new part of the CAP LTER website (http://caplter.asu.edu/capltertour or click on tour on the home page) is under development in which we are offering a forum for communicating CAP LTER research results to the broader community. The idea behind the virtual tour of CAP LTER is to illustrate key findings with brief, less technical explanations. The tour currently entails a presentation of research findings in the areas of geology, climatology, desert vegetation, pre-historic, historic and present urban land-use, and results from the Phoenix Area Social Study (PASS). The CAP LTER Tour is a work in progress and we propose to add more aspects of CAP LTER research when it becomes available.

Grossman-Clarke, Susanne[1], Diane Hope[2], Sang-Mi Lee[3], H. Joe S. Fernando[1], Peter G. Hyde[4], William L. Stefanov[5], and Nancy B. Grimm[6]. ***Modeling temporal and spatial characteristics of nitrogen dry deposition in the Phoenix metropolitan area.*** [1]Department of Mechanical and Aerospace Engineering/EFD, Arizona State University, Box 876106,Tempe, AZ 85287-6106; [2]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; [3]Department of Civil and Environmental Engineering, Arizona State University, Box 875306, Tempe, AZ 85287-5306; [4]Arizona Department of Environmental Quality, 1110 W. Washington Street, Phoenix, AZ 85007; [5]Department of Geological Sciences, Arizona State University, Box 871404, Tempe AZ 85287-1404; and [6]Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85827-1501.

Annual fluxes of NO_x-derived dry deposition in the Phoenix metropolitan area, along with its temporal and spatial characteristics, were predicted using a diagnostic model as well as the Community Multiscale Air Quality Model (Models-3/CMAQ). Input data for the diagnostic model included hourly pollutant concentrations measured at six air quality monitoring stations, meteorological variables and detailed land cover characteristics of the study area. NO_x dry deposition fluxes were simulated in the urban core area for the years 1996 and 1998. A Models-3/CMAQ simulation for 22-23 July 1996, was used to predict spatial patterns of NO_x and nitric acid dry deposition over the entire study area. Average annual NO_x-derived N deposition fluxes were found to be about 9 kg N $ha^{-1}yr^{-1}$ in the urban core area, 1.5 kg N $ha^{-1}yr^{-1}$ in the upwind desert and 10 kg N $ha^{-1}yr^{-1}$ downwind of the urban core. Nitric acid and NO_x dry deposition contributed 25 percent and 75 percent respectively to the total N deposition flux. Nitrogen dry deposition to the entire area was estimated to be 13.4 Gg yr^{-1}, 20 percent of total annual N inputs and therefore a significant term in the nitrogen mass balance of the urban ecosystem.

Grossman-Clarke, Susanne[1], Joseph A. Zehnder[2], and William L. Stefanov[3]. ***Effects of urban land cover modifications in a mesoscale meteorological model on surface temperature and heat fluxes in the Phoenix metropolitan area.***
[1]Department of Mechanical and Aerospace Engineering, Arizona State University, Box 876106, Tempe, AZ 85287-6106; [2]Department of Geography, Arizona State University, Box 870104, Tempe, AZ 85287-0104; and [3]Department of Geological Sciences, Arizona State University, Box 871404, Tempe, AZ 85287-1404.

A new land cover classification for the Phoenix metropolitan area was used in the fifth-generation PSU/NCAR mesoscale meteorological model MM5. The single urban category in the existing 25-category United States Geological Survey (USGS) land cover classification used in MM5 was divided into three classes: built-up urban, suburban mesic residential and suburban xeric residential. This allowed us to consider the influence of urban vegetation and irrigation practices in the surface energy budget and hence the evolution of the boundary layer. Thirty-meter land cover data were derived from LANDSAT Thematic Mapper (TM) satellite images. The data were upscaled to a 30-second grid and used to augment and correct the existing USGS land cover scheme in MM5.

Two 72-hour simulations starting on May 29, 2001 at 00:00 UTC were performed with MM5 on a 2 km x 2 km grid using (1) the old MM5 land use classification and (2) the new land use classification. Differences in the simulated turbulent energy fluxes and surface temperatures were evaluated for the two model versions.

Harlan, Sharon[1], Tom Rex[2], Larissa Larsen[3], Edward Hackett[1], Andrew Kirby[4], Shapard Wolf[5], Amy Nelson[6], Robert Bolin[1], Diane Hope[6], and Nancy Jones[7].
Community and environment in a desert metropolis. [1]Department of Sociology, Arizona State University, Box 872101, Tempe, AZ 85787-2101; [2]Center for Business Research, Arizona State University, Box 874011, Tempe, AZ 85287-4011; [3]School of Natural Resources, University of Michigan, Dana Building, 430 E. University, Ann Arbor, MI 48109-1115; [4]Department of Social and Behavioral Sciences, Arizona State University-West, 4701 W. Thunderbird Rd, Glendale, AZ 85306-3051; [5]Survey Research Laboratory, Arizona State University, Box 872101, Tempe, AZ 85287-2101; [6]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; and [7]School of Planning and Landscape Architecture, CAED, Arizona State University, Box 872005, Tempe, AZ 85287-2005.

Communities, social lives, values and behaviors must be understood in order to comprehend the place of humans in the environment. This is vitally important in the Phoenix metropolitan area, for decades one of the fastest-growing places in the country. Using results from the pilot study of the Phoenix Area Social Survey (PASS) we examined how communities form and work in this rapidly growing, low-density urban setting characterized by high rates of in- and out-migration and frequent residential mobility within the metropolis. Respondents were selected from an area probability sample of households within six neighborhoods in the city of Phoenix defined by census block groups. The neighborhoods, which represent different types of urban communities based on location, age of housing and household income, are co-located at CAP LTER Survey 200 monitoring sites. The findings show that community forms rapidly despite the high rate of migration, social diversity, and flux of the Phoenix area. People develop a sense of attachment at several geographic scales. They have clear ideas about what they value in their natural and built environments, with some striking agreement across socioeconomic strata. People also share deep concern about environmental conditions, particularly water quality and supply, industrial chemical releases, and air pollution. But their desires and concerns are not always in accord, and the disagreements seem paradoxical or illogical. Respondents in lower-income neighborhoods are more sensitive to environmental degradation in the Valley and in their own neighborhoods than those who are more prosperous. More affluent neighborhoods develop more social capital, which in turn makes them more successful in solving the problems they face.

Hope, Diane, and Corinna Gries. ***Core monitoring for CAPII - an interactive virtual poster display.*** Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211.

Proposals for core monitoring activities in CAP Phase II were recently drawn up under the following headings: primary productivity, populations, human dimensions, climate and watershed biogeochemistry and soils. In this poster we will present a

tabulation of those monitoring variables, incorporating feedback received from CAP researchers. We will also show how these monitored variables might link in with the activities currently being proposed under the five main Integrative Project Areas. The poster will be set up on the interactive projector system and we will invite symposium participants to spend a few minutes at the computer, to add their suggestions, comments and feedback, on how this scheme might be improved. We hope that the occasion of the annual poster symposium will help to invigorate participants with new ideas and insights on the meshing of core monitoring activities with the new thrust of the research questions being forged for CAP II. All contributions to the poster will be stored and used in the development of the renewal proposal.

Hope, Diane[1], Susanne Grossman-Clarke[2], Sang-Mi Lee[3], H. Joe S. Fernando[2], Peter G. Hyde[4], William L. Stefanov[5], and Nancy B. Grimm[6]. ***The importance of dry deposition to the nitrogen mass balance of an arid urban ecosystem***.
[1]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; [2]Department of Mechanical and Aerospace Engineering/EFD, Arizona State University, Box 876106, Tempe, AZ 85287-6106; [3]Department of Civil and Environmental Engineering/EFD, Arizona State University, Box 875306, Tempe, AZ 85287-5306; [4]Arizona Department of Environmental Quality, 1110 W. Washington Street, Phoenix, AZ 85007; [5]Department of Geological Sciences, Arizona State University, Box 871404, Tempe AZ 85287-1404; and [7]Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501.

Anthropogenic emissions of oxidized nitrogen species to the atmosphere in and adjacent to urban areas are typically high, particularly as a result of the combustion of fossil fuels. In arid regions a significant proportion of these emissions are deposited in the dry form. The aim of our study was to quantify the temporal and spatial variation in NO_x-derived N dry deposition fluxes for the Phoenix metropolitan area, in order to quantify the annual contribution of nitrogen dry deposition to the Central-Arizona Phoenix (CAP) Long-Term Ecological Research (LTER) study area. Dry N deposition may represent a significant input in the N mass balance of the CAP urban ecosystem, although to date the lack of a reliable estimate of this term has represented a key uncertainty in the calculations.

We used a diagnostic model to determine predict seasonal variations in hourly deposition fluxes at six air quality monitoring stations, in combination with the Community Multiscale Air Quality Model - Models 3 to predict spatial patterns of NOx and nitric acid dry deposition over the entire study area. The model estimates were significantly improved using a land cover characteristics of the study area determined from a satellite land classification of the region, supplemented by detailed ground-based information on surface cover types in each land cover type, from an extensive field survey.

Average annual NO_x-derived N deposition fluxes were found to be about 9 kg N $ha^{-1}yr^{-1}$ in the urban core area, 1.5 kg N $ha^{-1}yr^{-1}$ in the upwind desert and 10 kg N

$ha^{-1}yr^{-1}$ downwind of the urban core. Nitrogen dry deposition was 13.4 Gg N yr^{-1}, which represents 20% of total nitrogen inputs and hence is a significant term in the mass balance of the urban ecosystem.

Ivanich, Paul A., James A. Tyburczy, J Ramón Arrowsmith and Mimi Diaz. ***Measuring bedrock topography using gravity to understand subsidence along a portion of the CAP canal in northeast Scottsdale.*** Department of Geological Sciences, Arizona State University, Box 871404, Tempe, AZ 85287-1404.

Subsidence due to groundwater withdrawal and resulting sediment compaction is a serious problem in the Basin and Range province of the southwestern United States. Remote sensing InSAR (Interferometric Synthetic Aperture Radar) data show a large subsidence bowl, approximately 4 km by 2 km, centered near Via Linda and Frank Lloyd Wright Boulevard in northeast Scottsdale, Arizona (Pool 24 subsidence feature). The CAP (Central Arizona Project) canal has subsided approximately 0.5 meters (1.5 feet) here since construction in the late 1980s. This subsidence is a threat to the canal's maximum flow capacity, and has forced the CAP to raise the canal liner at a cost of more than $300,000. The Pool 24 feature and four additional ellipsoid subsidence bowls to the northwest trend N50W to N60W. Their attitudes and shapes suggest a large structurally controlled zone of subsidence along the southwestern McDowell Mountain-front.

We have performed a high sensitivity relative gravity survey, including elevation control using differential GPS, to measure microgal variations in the earth's gravitational field on the Pool 24 subsidence feature. These variations are caused by density contrasts between bedrock and alluvium. 540 gravity stations in an approximately 16 square kilometer area around the canal were established. These measurements are used to model the bedrock topography beneath the canal area. The residual gravity anomaly shows depth to bedrock increasing to the southwest, away from the mountain front. Features in the residual surface seem to correspond to boundaries of the subsidence bowl, and may indicate bedrock control on its attitude and shape.

Jenerette, G. Darrel, and Jianguo Wu. ***Multiple scale spatial variation of terrestrial ecosystems in an urbanized desert region.*** Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

How do ecological, geological, and sociological processes affect soil biogeochemical variability at multiple scales in the central Arizona-Phoenix (CAP) region? Preliminary results from a regional survey demonstrated substantial variability in soil chemistry throughout the CAP. Do finer scale patterns of soil chemistry exhibit similar heterogeneity, and is this heterogeneity controlled by factors similar to the regional scale? To address these questions we sampled six sites in the CAP region in

the spring of 2002. Sites were chosen from the dominant patch types in this region including two desert patches, one inside and one outside the urban boundary, two residential patches, one over 30 years old and one less than 5 year old, and two agricultural patches, one in an alfalfa field and one in a cotton field. We sampled each site using a spatially stratified, dual density design encompassing a 6400 meters2 extent with a minimum grain size of 6.25 m. At each sampling point we collected a soil core, topography, and vegetation data. Means of bulk density, soil organic matter (SOM), water content, pH, and vegetation distribution differed significantly between sites. The correlation structure between these variables also changed between sites, for example, SOM was positively correlated to topography at some sites and negatively at others. Spatial structure also varied between sites; some sites had congruence in the range of spatial correlation between different ecosystem variables, while at others there was no such congruence. These results show both the broad diversity and consistencies of spatial patterns exhibited in this region.

Jones, Nancy S.[1],Anthony Brazel[2],Christopher Eisinger[3], Sharon Harlan[4], Brent Hedquist[2], Sara Grineski[4], G. Darrel Jenerette[5], Larissa Larsen[6], Matthew Lord[2], John Parker[4], Lela Preshad[3], William L. Stefanov[3], and Danielle Zeigler[7]. ***Neighborhood ecosystems: Human-vegetation-climate interactions in a desert metropolis.*** [1]School of Planning and Landscape Architecture, CAED, Arizona State University, Box 872005, Tempe, AZ 85287-2005; [2]Department of Geography, Arizona State University, Box 870104, Tempe, AZ 85287-0104; [3]Department of Geological Sciences, Arizona State University, Box 871404, Tempe, AZ 85287-1404 [4]Department of Sociology, Arizona State University, Box 872101, Tempe, AZ 85787-210; [5]Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601; [6]School of Natural Resources, University of Michigan, Dana Building, 430 E. University, Ann Arbor, MI 48109-1115; and [7]Department of Geosciences, Fort Hayes State University, 600 Park Street, Hays, KS 67601-4099.

This project investigates the interactions of human activities and biophysical-climatological processes on a neighborhood scale in the Phoenix, Arizona, metropolitan area. We have performed a pilot comparison of vegetation abundance, ground temperatures, and climatic variables (air temperature, humidity, and levels of shade) with demographic data (income level, ethnicity, etc.) and neighborhood vegetative indices (NDVI and SAVI) as part of NSF's Research Experience for Undergraduates summer project. Our initial results from six neighborhoods did not suggest a strong correlation between physical and social variables possibly due to the narrow variability of biophysical neighborhood characteristics among the sites chosen. We have added further neighborhoods over a larger range of the biophysical variables and are looking at the entire metropolitan area at the census tract scale to further investigate relationships this spring both as part of a Biocomplexity NSF grant and IGERT workshop. This also involves using detailed

energy-water use data, as well as a more detailed field data sampling strategy, to further investigate social-physical neighborhood processes and feedbacks.

Katti, Madhusudan, and Peter McCartney. ***The distribution of bird species diversity in the Phoenix metro area: Visualizing the spatial patterns of diversity in an expanding urban matrix.*** Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211.

Birds are among the most conspicuous wild animals in urban areas, and serve as useful indicators of biological diversity. Information on the diversity and distribution of birds can therefore not only inform our understanding of how cities affect other species, but also help urban planners in guiding future development in ways that can maintain and enhance urban biodiversity. The bird-monitoring project in CAP LTER has conducted regular censuses since October 2000 to quantify the distribution and abundance of all bird species occurring throughout the Phoenix metro area. We monitor birds four times a year, at 51 sites in four major land-use categories: urban (18 sites), desert (15), riparian (11), and agricultural (7). During the first two years of monitoring, we recorded 166 species in the area. Overall, riparian sites had the most species (148), followed by agriculture (89), desert (81), and urban (77). We have previously studied the relationships between species diversity and habitat and socio-economic characteristics. Here we explore the spatial patterns of bird species distribution across the entire landscape matrix, using mapping tools from ArcGIS. We present a series of maps that visualize the distribution of bird diversity in terms of seasonality, land use, human income, and the status of birds: resident, migratory, native, or invasive. These maps are being developed as part of a website that will allow scientists, citizens, and urban planners to explore these relationships visually and interactively. Such visualization tools can help disseminate the results of our long-term monitoring among a wider audience of citizens and decision-makers that will shape the future development of Phoenix and other metropolitan areas.

Katti, Madhusudan, Eyal Shochat, and J. Marty Anderies. ***Living in the city: Resources, predation, foraging behavior, and population dynamics.*** Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211.

Urbanization results in higher bird population densities, even as species diversity declines. Studies suggest that this is due to higher resources (amount and input rate) and/or lower predation. Optimal foraging models predict that birds should distribute themselves among habitat patches in proportion to the resource input rates in those patches, and that net fitness or payoff should be equal across habitats. Our empirical studies (we measured giving up densities, GUD, in artificial

food patches) of birds foraging in urban and desert habitat failed to support this prediction. We found urban GUDs to be significantly lower than desert GUDs, suggesting overexploitation in resource-rich urban patches. This should increase fitness costs: potentially poorer body condition or smaller lifespan in the high-density habitat. Nevertheless, urban bird densities remain consistently higher. We believe this results from urban resource inputs being more predictable (and higher) than in desert, allowing poorer quality individuals to persist, thereby inflating densities. Here, we present a mathematical modeling approach that provides some insights into this seemingly paradoxical phenomenon.
We model population growth in a habitat as a function of:

- available resources, with a fixed or variable input rate
- body condition of individuals, an energy variable, which depends on
  - competitive ability of individuals
  - metabolic costs
- death rate (including predation risk)

We explore the population dynamics of two phenotypes differing in body condition, under a range of resource input and predation rates. While the results we present here are preliminary, they illustrate how relatively simple changes (e.g., resource input rates) that affect bird behavior, might aggregate to the very different community level patterns seen in cities.

Kaye, Margot[1], Anthony Brazel[2], Maik Netzband[1], and Madhusudan Katti[1].
Perspectives on a decade of climate in the CAP LTER region. [1]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; and [2]Department of Geography, Arizona State University, Box 870104, Tempe, AZ 85287-0104.

Climate of the Phoenix basin has varied considerably since the CAP LTER was established in 1997. We compared monthly precipitation values for the past 5 years to precipitation variability over the past 50 years and we examined the synoptic-scale climate patterns that drive Phoenix climate to gain a longer-term and broader-scale perspective of recent climate in Phoenix. We found many deviations in monthly, seasonal, and annual precipitation patterns. For example, several of the past 5 years have experienced above-average (based on the past 50 years) monthly precipitation values, while showing below-average seasonal or annual values. Some years, especially 2000, show a deviation from the typical timing of summer precipitation. All years experienced an extended dry period during May and June. This variability in monthly, seasonal, and annual precipitation has direct impacts on ecological variables measured at the CAP LTER. We compared variability in precipitation to patterns in ecological data collected over the past five years, such as animal and plant abundance and diversity and images from remote sensing, to

determine how a broader perspective on climate may affect our interpretation of ecological data.

Klett, Mark[1], Matthew Alan Lord[2], and Michael Lundgren[1]. ***A rephotographic survey of landscape change and persistence for the Greater Phoenix 2100 Project.*** [1]School of Art, Arizona State University, Box 871505, Tempe, AZ 85287-1505; and [2]Department of Geography, Arizona State University, Box 870104, Tempe, AZ 85287-0104.

CAP LTER scientists and other researchers have made substantial contributions to the understanding of changes occurring in metropolitan Phoenix using techniques such as remote imaging interpretation and on-site environmental data collection. Their research findings typically have been presented in text, cartographic, or tabular form. Because landscape photography more closely approximates our lived experience in the environment, it has the capacity to make more accessible to the public and policy makers many of the ideas the scientific community is exploring. Ground based repeat photography is a readily comprehensible complement to the other communicative tools planned for the Greater Phoenix 2100 (GP2100) effort. This rephotographic survey of landscape change and persistence will provide a public interface for GP2100, thereby helping to achieve that project's objective of informing the decision-making process.

This survey will use repeat photographs of both historic and newly chosen sites to integrate cultural landscapes into the science that will inform GP2100. This pilot study will include a number of historic images for rephotography. It will also incorporate a set of new locations to be rephotographed at regular intervals. The resulting images will be archived and made accessible to those affiliated with GP2100 and the general public. Scientific advisors to this study, representing perspectives in several disciplines will be crucial to its success. These advisors will assist with site selection and interpretation of the resulting photographs for a general audience. This collaboration between photographers and life, earth, and social scientists thus has the potential to communicate powerfully the concerns of the CAP LTER community to area residents concerned about the future of metropolitan Phoenix.

Lewis, David Bruce[1], Linda B. Stabler[2], and Chris A. Martin[2]. ***Ecological stoichiometry of horticulture: Consequences of pruning and irrigation for plant and soil chemistry.*** [1]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; and [2]Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

Ecological stoichiometry examines how ecological entities obtain the multiple chemical resources required for growth, and how they consequently alter the

environment by processing these resources. The tissue chemistry of an organism reflects the needs of the organism's physiological processes and the resources actually available. Physiological processes often require nutrients in ratios that, while narrow, are still flexible enough to maintain growth under stressful conditions. Greater nutrient use efficiency (NUE), for instance, suggests that organisms grow more (incorporate more carbon, C) per unit of resource (nitrogen, N, and phosphorus, P).

In urban ecosystems, horticultural practices contribute to stress experienced by plants, potentially altering their NUE. We used an experiment to test the general hypothesis that stressful conditions imposed by horticultural practices enhance plant NUE, measured as C:N and C:P ratios. In particular, we hypothesized that (i) NUE is enhance by pruning, (ii) NUE is depressed by irrigation, (iii) NUE is influenced by an interaction between pruning and irrigation, and (iv) NUE is not influenced by horticulture. This experiment followed a factorial design, in which replicate individuals of both Texas sage (*Leucophyllum frutescens*) and oleander (*Nerium oleander*) were treated with high vs. low irrigation crossed with no vs. frequent (once per 6 weeks) pruning. Plant tissue chemistry was measured during both a damp, cool (February) and hot, dry (July) context. Hypothesis (ii) was best supported. Oleander C:N and C:P ratios, and the Texas sage C:P ratio, were all depressed by irrigation during the hot period of July. Additionally, the Texas sage C:N ratio was depressed by irrigation in February. While some data supported hypothesis (i), most data actually contradicted it. During July, both nutrient ratios of both species were depressed by pruning. No data supported hypothesis (iii) and few data supported hypothesis (iv), as C:P ratios of both species were unaffected by horticulture during the cooler period of February. Horticultural effects on NUE may thus vary among species, the nutrient considered, and seasons. Because nutrient cycling in plants and soils are tightly coupled, we will also report how patterns in soil and plant chemistry compare among experimental treatments. Because varied horticultural practices are central to the culture of ever-expanding urban ecosystems, these plant-level modifications of NUE may have a profound effect on net ecosystem productivity, nutrient uptake, and gas and water exchange with the atmosphere.

Mahkee, Darin K., and Chris A. Martin. ***Leaf morphology of four landscape taxa in response to irrigation volume and pruning frequency***. Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

In the urban Southwest, trees and shrubs in managed landscapes are subjected to a wide range of irrigation rates and pruning regimes that may affect environmental stress tolerance. Plant responsiveness to environmental stress is often expressed as changes in leaf morphology that might affect both leaf size and thickness. Thicker, smaller leaves are advantageous to vegetation growing in nutrient poor, and/or dry sites, as they provide for nutrient retention, and protect against desiccation. We measured the leaf size and thickness of two shrub taxa (*Leucophyllum frutescens*

var. green cloud and *Nerium oleande*r 'Sister Agnes') and two tree taxa (*Eucalyptus microtheca* 'Blue Ghost' and *Quercus virginiana*) growing in 14, four-year old established landscape plots in Phoenix, Arizona. Tree taxa in each plot were subjected to either a high or low irrigation rate, whereas shrub taxa in each plot were subjected to a single combination of a factorial of two irrigation rates (high or low) and four pruning treatments (every six weeks, every six months, once yearly, unpruned). For each taxa x treatment combination, 50 leaves were randomly sampled and leaf area and fresh mass were measured within 3 h. Leaves were then dried for at least 48 h at 65°C, after which dry mass was measured. Specific leaf mass (SLM) was then calculated as the ratio of leaf mass per unit area ($kg \bullet m^{-2}$). We found that SLM of *Leucophyllum* was affected only by pruning (P>F 0.0001). We also found that SLM of *Nerium* was affected by an interaction of irrigation and pruning treatments (P>F 0.0004). SLM of *Eucalyptus* was not affected by irrigation rate (P>F 0.6805), whereas SLM of *Quercus* increased with high irrigation (P>F 0.0001). These data suggest that stress tolerance of *Nerium* and *Leucophyllum* is differentially affected by horticultural practices.

Martin, Chris[1], Paige Warren[2], and Ann Kinzig[3, 4]. ***Landscape vegetation in small urban parks and surrounding neighborhoods: Are socioeconomic characteristics a useful predictor of vegetation taxa richness and abundance?*** [1]Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601; [2]Biology Department, 2119 Derring Hall, Virginia Polytechnic Institute and State University, Blacksburg ,VA 24061; [3]Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501; and [4]Center for Environmental Studies, Box 873211, Arizona State University, Tempe, AZ 85287-3211.

We studied the composition of landscape vegetation within an array of 16 small urban parks (4-15 acres) and surrounding residential neighborhoods in Phoenix, Arizona, during 2000 and 2001. We then analyzed vegetation composition data in terms of neighborhood socioeconomic characteristics to determine if neighborhood socio-economic rank (SER) could be used as a predictor of landscape vegetation taxa richness and abundance. The urban parks that we studied were distributed within similarly dense residential neighborhoods of three SER: high, moderate, or low. Counts and taxonomic identification of all woody perennial vegetation in each park were made. To approximate composition of landscape vegetation in the neighborhood surrounding each park, counts and taxonomic identification of all woody perennial vegetation were made along four transects distributed away from the park along streets in a northerly, easterly, southerly or westerly direction, respectively. Transects were 80 m in length and extended to a width of about 20 to 30 m away from the edge of either side of the street, or about the depth of a front yard residence. We found that SER could be used to help predict abundance and richness of landscape vegetation in neighborhoods surrounding parks, but not in parks themselves. Richness of neighborhood vegetation taxa increased with an

increase in neighborhood SER. Landscape vegetation abundance was highest for neighborhoods with high SER, but was similar for neighborhoods with moderate or low SER. Neighborhood vegetation taxa richness was positively correlated with median family income (R^2 adj.=0.72), but negatively correlated with number of years since neighborhood development (R^2 adj. =0.33), and percent Hispanic/Latino population (R^2 adj.=0.73). These data suggest that vegetation composition of small parks in Phoenix was dominated by top-down influences reflecting city management. Conversely, vegetation composition of neighborhoods surrounding parks appeared more dominated by integrated bottom-up influences of neighborhood residences and socioeconomic factors.

Marussich, Wendy A., and Stanley H. Faeth. ***Comparing trophic dynamics in urban and desert ecosystems using arthropod communities on brittlebush (*Encelia farinosa*).*** Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501

Do trophic dynamics differ in urban vs. "natural" systems? Is trophic structure controlled by "top-down" (natural enemies) or "bottom-up" (limiting nutrients) forces in these systems? To address these questions, we have established long-term arthropod monitoring experiments on brittlebush (*Encelia farinosa*) at two permanent LTER study sites (President's House and Desert Botanical Gardens) and one natural desert preserve (Usery Mountain Park). Brittlebush was selected because it is a common native desert perennial that is often used in urban landscaping. At the President's House and the Desert Botanical Gardens, we planted 40 brittlebush plants in an 8 x 5 grid with 1.5 meter spacing, while at Usery Mountain Park, we are using 40 naturally occurring brittlebush plants. At the three sites, we are manipulating water availability and the access of predators (both birds and/or ground arthropods) in 2 x 4 factorial design. We are sampling the arthropod community and plant damage once per month, and applying the water treatment every two weeks. Arthropods are being identified to family and feeding-guild. By using the LTER permanent sites we will link these experiments to other LTER core areas by quantifying changes in ecosystem function (e.g., productivity, P/R ratios, organic matter accumulation) as functions of trophic complexity and patch type. Ultimately, we will combine our experimental results with a patch dynamic model to better understand how inter-patch differences in tropho-dynamics impact regional fluctuations in plants, herbivores, and predators.

McCartney, Peter, Corinna Gries, Robin Schoeninger, Amy Sundermier, and Edward Gilbert. ***The Southwest Environmental Information Network (SEINet)****.* Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211.

The Southwest Environmental Information Network (SEINet) is a new web site hosted by the Center for Environmental Studies that provides a central gateway to multiple data resources in Arizona and beyond. Series of software tools developed under our "Networking our Research Legacy" project provide the back-end components for a set of search engines and online visualization features for accessing citation indexes, datasets, biodiversity databases, taxonomic name catalogs, and identification keys. SEINet brings data to users in a central, user-friendly interface and sets the stage for more advanced projects in data and model integration.

McCulley, Rebecca[1], and Jason Kaye[2]. ***Soil microbial communities in urban ecosystems compared to nearby native grasslands and agriculture.***
[1]Department of Biology, Duke University, 133 Biological Sciences, Durham, NC 27708; and [2]Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501.

One of the fastest growing regions in the country is the Front Range of Colorado where rapid urbanization occurs within a matrix of semiarid grasslands and dryland agriculture dissected by irrigated agriculture near water sources. We previously reported that urbanization in this region altered ecosystem-level soil characteristics such as carbon and nitrogen storage and soil-atmosphere greenhouse gas exchange. Because these ecosystem-level characteristics are controlled, in part, by soil microorganisms, we further hypothesized that urbanization altered the structure and function of the soil microbial community. We used phospholipid fatty acid (PLFA) analysis and laboratory incubations to measure the soil microbial community composition (structure) and potential C and N mineralization rates (function) in urban lawns, native grasslands, dryland wheat fields and irrigated corn fields near Fort Collins, Colorado. Urban lawns generally had higher microbial biomass and potential C and N mineralization rates than other ecosystems, suggesting that energy and nutrient availability to microorganisms are elevated in urban ecosystems. Urbanization did not dramatically change the structure of the soil microbial community. However, small but significant differences across ecosystem types were found in fatty acids indicative of gram negative, anaerobic bacteria and fungi. An increased relative abundance of anaerobic microorganisms in soils that were formerly semi-arid suggests that urban irrigation practices are affecting microbial community structure. Concurrently, we found that soil-to-atmosphere fluxes of a greenhouse gas produced by anaerobic soil bacteria (N_2O) were highest in urban lawns and irrigated corn fields. These data provide a direct link between

changes in microbial community composition and the ecosystem level consequences of urbanization.

Musacchio, Laura[1,2]. ***Landscape ecological classification and analysis of a 100-year floodplain corridor in the Phoenix metropolitan region.*** [1]School of Planning and Landscape Architecture, Arizona State University, Box 872005, Tempe, AZ 85287-2005; and [2]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211.

This pilot study examines patch and corridor characteristics of landscape patterns in the 100-year floodplain corridor of a transect from downtown Phoenix to Buckeye that could affect water quality, habitat quality, and flooding risks. It is the first phase of a study that is developing a system simulation model and GIS model for the evaluation of alternative conservation and restoration scenarios for the 100-year floodplain in this transect. Six variables of interest are utilized in order to classify and analyze patch and corridor characteristics in the transect: land-use type, land ownership type, vegetation type, floodplain location, river reach location, and road location. The classification scheme utilizes these six variables and develops a topology of landscape patterns for the 100-year floodplain in the transect. The analysis examines the changes and transitions in these landscape patterns for different urban and rural settings, such as central city, first-ring suburb, second-ring suburb, unincorporated county land, and rural town. The results of the classification and analysis process will aid understanding about the trends and patterns in landscape ecological structure and function of the floodplain and riparian corridor in the transect. In addition, these results will be used for the selection of representative sites for use in the system simulation model and GIS model.

Netzband, Maik[1], and William L. Stefanov[2]. ***Remote sensing and landscape metrics for global urban ecological monitoring.*** [1]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; and [2]Department of Geological Sciences, Arizona State University, Box 871404, Tempe, AZ 85287-1404.

A research program that provides the opportunity to apply CAP LTER research results on a global scale is the Advanced Space-borne Thermal Emission and Reflection Radiometer Urban Environmental Monitoring (ASTER UEM) program. The primary goal of the UEM program is to monitor land cover and land use change over a six-year period for approximately 100 global urban centers. Land cover classification techniques developed for the CAP LTER project are being applied to ASTER UEM data.

The primary application of remote sensing data in this study is to provide a means for extrapolating detailed measurements at local sites to a regional context. Specifically, multi-spectral image classification and texture analysis will be used to identify land cover types, such as different grasses, crop, trees, soils, man-made materials, water, and native vegetation. Because modifications of the urban environment are coupled frequently with modifications of the spatial structure, the investigation of texture and shape parameters or neighbourhood relations out of remote sensing data apart from the spectral investigation applied so far represents an additional analysis potential.

Perry, Dana[1], James Anderson[2], and Peter R. Buseck[1,3]. ***Analysis of atmospheric particles deposited onto mesquite leaves in the Central Arizona - Phoenix LTER area.*** [1]Department of Chemistry and Biochemistry, Arizona State University, Box 871604, Tempe AZ 85287-1604 ; [2]Department of Mechanical and Aerospace Engineering, Arizona State University, Box 876106, Tempe AZ 85287-6106; and [3]Department of Geological Sciences, Arizona State University, Box 871404, Tempe AZ 85287-1404.

Atmospheric particles on mesquite leaves were analyzed in order to determine the spatial deposition patterns of various particle types throughout the Phoenix area. Individual particles on the leaves were analyzed for their sizes and compositions using an electron microprobe, and the chemical data were subjected to statistical analyses, which grouped the particles by composition. Aluminosilicates, calcium silicates, sulfates, chlorine-rich, and potassium-rich particle groups emerged. Most of the chlorine- and potassium-rich particles originated from the leaves, while most of the others originated from the atmosphere. The aluminosilicates were observed at all sampling sites, and they were most abundant at sites in the southern part of the sampling domain, where agricultural activities exist; the aluminosilicates were likely generated locally. The calcium silicates were also observed at all sampling sites, but they were most abundant at a site in the northwestern part of the region. The calcium particles may have originated from soil, fertilizer, or cement that is locally generated. The sulfate particles were less abundant than the silicates and were not observed at all sampling sites. The highest concentrations were observed in the eastern part of the sampling domain, where high concentrations of sulfate particles were observed in ambient air samples collected in a previous study. That study concluded the sulfate particles were transported to that area by thermally driven terrain-controlled air flows. The results from the present study show that particles on leaves can be used to measure the spatial deposition patterns of particle types, patterns that are determined by prevailing particle transport paths superimposed on the regional distribution of particle sources.

Roach, W. John, and Nancy B. Grimm. ***Nutrient cycling along an urban desert lake chain: The effects of anthropogenic modifications of Indian Bend Wash.*** Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501.

Indian Bend Wash is an urban desert stream characterized by a string of shallow artificial lakes whose water levels are maintained by anthropogenic diversions as well as periodic flooding. Modifications of the hydrology and morphology of the wash affect both nitrogen and phosphorus cycling. Analysis of samples collected on seven dates from approximately 17 sites along a 4-km section of the wash suggest that nutrient concentrations are highly variability both in space (coefficients of variations as high as 226% for nitrate and 90% for SRP) and in time (average concentrations ranged from 0.055 mg/L to 5.46 mg/L for nitrate and from 0.004 mg/L to 0.093 mg/L for SRP). Although some of this variation appears to be a function of the different water sources, lake-specific factors also appear important. We quantified diel fluctuations in water chemistry in three of the lakes during July 2001. Diel changes in dissolved oxygen and nitrate concentrations were most striking in the shallowest lake where DO increased by approximately 20 mg/L as nitrate declined by 1 mg/L, but were more modest in the deeper lakes.

Roberts, Mark, Mele Koneya, Peter Burnett, Rita Walton, Don Worley, and Anubhav Bagley. ***Land use and socioeconomic modeling at MAG.*** Information Services Division, Maricopa Association of Governments, 302 North 1st Ave., Suite 300, Phoenix, AZ 85003.

The Maricopa Association of Governments (MAG) is responsible for regional land use, transportation, and air quality modeling for the Phoenix metropolitan area. Like other regional governments with similar Metropolitan Planning Organization (MPO) responsibilities, MAG has been seeking to enhance these models. GIS has played a major role at MAG for the past twelve years. In recent years, MAG has been developing new classes of planning models that run completely in the GIS environment.

The land use, population and socioeconomic modeling at MAG is based on a three-tier modeling process. The first tier is a demographic model that is used to produce county control totals. The second tier involves using a spatial interaction model to allocate the county control total population and employment to sub regions. The third tier allows for the allocation of the sub regional population to smaller areas drawing upon GIS representation of land use plans and local policies of MAG member agencies.

This poster describes the Socioeconomic Modeling process at MAG. It describes the variety of GIS data utilized, the three-tier modeling process and the ancillary sub-models and processes, and also the review process followed to develop a regional set of projections.

Ross, Matthew S.[1], David Jennings[1], Christopher Putnam[2], Thomas Small[1], and Pierre Deviche[1]. ***Home range sizes of Cactus Wrens (*Campylorhynchus brunneicapillus*) at Arizona State University***. [1]Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501; and [2]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211.

Previous researchers have studied home range size in relation to habitat use. However, it has yet to be investigated how home range size varies with other environmental factors. In this study we investigated the effects of time of day on home range size. Four adult Cactus Wrens were mist netted on the campus of Arizona State University and fitted with 1.93-g radio transmitters (Holohil Systems Ltd.). Birds were located three times a day: morning (0645-1115 hrs), afternoon (1200-1400 hrs), and evening (1600-1845 hrs). Each bird was located on average 36 times over a four-week period in late summer and early fall. Bird locations were made visually and transferred to ArcView GIS 3.1 software (Environmental Systems Research Institute). Home ranges were calculated using the Adaptive Kernel (AK) method and the Mean Convex Polygon (MCP). Home ranges calculated with the AK method decreased by an average of 62.1% (0.77 km^2 to 0.48 km^2) between morning and evening. Average afternoon home range was 0.59 km^2. Home ranges calculated with the MCP method decreased 60% from morning to evening. Results of this study indicate the necessity to include time of day in radiotelemetry studies on home ranges and movement patterns.

Schaafsma, Hoski[1], Kris Gade[2], Michelle Elliott[3], Destiny Crider[3], Cathryn Meegan[3], and Steve Swanson[3]. ***Investigating environmental and social heterogeneity in a landscape perspective: A Hohokam case study.*** [1]Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601; [2]Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501; and [3]Department of Anthropology, Arizona State University, Box 872402, Tempe, AZ 85287-2402.

Traditionally, Hohokam archaeological investigations divide the prehistoric Phoenix basin into core and periphery areas. The core consists of the area of greatest settlement along the Salt and Gila Rivers. The periphery is the surrounding area outside the canal-irrigated portions of the basin. Many researchers assume that periphery sites are more similar to each other than to core area sites. We compare the spatial and temporal patterning of environmental and archaeological data from two drainages in the northern periphery and one in the core to determine if finer scale patterns of environmental and social heterogeneity can be detected between them. We focus on the period 900 to 1200 AD, an important cultural transition from the pre-Classic to the Classic Period, and use published archaeobotanical, ceramic,

and public architecture data. Archaeobotanical samples are used to infer "background" vegetation, as well as agricultural plant communities. Through ceramic data, we examine the degree of local versus imported wares to determine the levels of trade and interaction between drainages and other regions. The presence and form of public architecture at sites is used to infer the level of participation in the larger Hohokam religious and social system.

We find significant social and environmental differences both temporally and spatially. The northern periphery drainages show contrasting cultural and environmental signatures; with one more closely resembling the patterning associated with the core Salt River communities. These results suggest that a drainage-based approach in Hohokam archaeology will reveal a more comprehensive understanding of inter- and intraregional social interaction.

Stabler, Linda B., and Chris A. Martin. ***Carbon and water relations of*** **Nerium oleander** ***in simulated urban landscapes.*** Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

Terrestrial primary productivity is most limited by water availability in the Sonoran Desert, but it is unclear to what extent heterogeneous management practices affect carbon and water relations of plants in irrigated urban landscapes in the CAP LTER study area. Plant growth, gas exchange fluxes, and mass sap flow were monitored in response to a 2x4 factorial matrix of irrigation volume (high or low) and pruning frequency (every 6 weeks, 6 months, yearly, or unpruned controls) to elucidate how these practices affect productivity and water relations of *Nerium oleander*. High irrigation volume increased yearly productivity and plants pruned yearly or left unpruned were more productive than those pruned more frequently. On a leaf area basis, irrigation volume did not affect carbon assimilation (A) or transpiration (E), but unpruned controls had lower fluxes of A and E than pruned plants. Preliminary estimates of whole-plant leaf surface area (LSA) show interactive effects of irrigation and pruning, which translate to effects on A and E scaled to the whole plant. Preliminary analyses of mass sap flow data show that in general, smaller plants have higher rates of mass sap flow on a leaf area basis, while larger plants have higher rates on a whole plant basis. Estimated treatment effects on E based on mass sap flow data show similar patterns to estimates derived from gas exchange data. These data show that total plant carbon uptake and water loss in oleander are most closely related to total LSA and suggest that estimates of total LSA might be the best predictor of primary productivity and transpiration in irrigated Sonoran Desert landscapes.

Stefanov, William L.[1,2]. ***Assessment of landscape fragmentation associated with urban centers using ASTER data.*** [1]Department of Geological Sciences, Arizona State University, Box 871404, Tempe, AZ 85287-1404; and [2]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211

The realization that virtually all ecosystems on Earth have experienced some degree of human alteration or impact has highlighted the need to incorporate humans (and their environmental effects) into ecosystem models. Land cover and land use changes associated with urbanization are important drivers of local geological, hydrological, ecological, and climatic change. Quantification and monitoring of these changes in 100 global urban centers are part of the primary mission of the ASTER instrument on board the NASA Terra satellite, and comprise the fundamental research objective of the Urban Environmental Monitoring (UEM) Program at Arizona State University. Data have been acquired for the majority of the target urban centers and are used to compare landscape fragmentation patterns on the basis of land cover classifications.

Land cover classifications of urban centers are obtained using visible through mid-infrared reflectance and emittance spectra together with calculated vegetation index and spatial variance texture information (all derived from raw ASTER data). This information is combined within a classification matrix, using an expert system framework, to obtain final pixel classifications. Landscape fragmentation is calculated using a pixel per unit area metric for comparison between 55 urban centers with varying geographic and climatic settings including North America, South America, Europe, central and eastern Asia, and Australia. Temporal variations in land cover and landscape fragmentation are assessed for nine urban centers (Albuquerque, New Mexico, USA; Baghdad, Iraq; Las Vegas, Nevada, USA; Lisbon, Portugal; Madrid, Spain; Riyadh, Saudi Arabia; San Francisco, California, USA; Tokyo, Japan; and Vancouver, Canada). These data provide a useful baseline for comparison of human-dominated ecosystem land cover and associated regional landscape fragmentation. Continued collection of ASTER data throughout the duration of the Terra mission will enable further investigation of urban ecosystem trends.

Stuart, Diana[1], Madhusudan Katti[1], and Will R. Turner[2]. ***The r(iparian) factor: A comparison of Phoenix and Tucson avifauna.*** [1]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; [2]Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ 85721.

Riparian habitats are important centers of diversity, especially in arid landscapes. In the American Southwest, all riparian habitats have experienced strong pressure from human activity. We investigate bird species diversity in four types of riparian habitat in an urban context.

Using 15-minute point counts conducted four times per year by three separate observers, two years of bird population data have been collected at 40 sites randomly selected from the "200 Point Survey" throughout the CAP LTER study area (Maricopa County, Arizona, USA). In addition, data have been collected at 12 riparian sites systematically selected throughout the same study area. The riparian sites are of four types: Permanent natural; permanent engineered; ephemeral natural; and ephemeral engineered.

Using the data from the Phoenix-area Spring counts of 2001 and 2002, we compare the results from the same time period at similar sites in the Tucson area from the Tucson Bird Count, and TBC Park Monitoring projects.

Spring 2001 followed a winter of above-average rainfall, while Spring 2002 followed an exceptionally dry winter. Our poster compares bird species richness and abundance from both metropolitan areas, for both spring counts, and from all four riparian site types. Our CAP LTER data suggest that permanent riparian sites have the highest species richness in all years. We test the hypothesis that ephemeral sites have higher richness than urban sites in wet years, but lower richness than urban sites in dry years.

Swanson, Steve[1], Destiny Crider[1], Cathryn Meegan[1], Michelle Elliott[1], Kris Gade[2], and Hoski Schaafsma[3]. ***Long-term cultural and ecological responses to changes in climate in Central Arizona AD 900 - AD 1200.*** [1]Department of Anthropology, Arizona State University, Box 872402, Tempe, AZ 85287-2402; Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501; and [3]Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

This poster reports the results of an interdisciplinary Urban Ecology IGERT workshop examining the resilience of a prehistoric Socio-Ecological System (SES) in the Phoenix Basin area. Data collected by the CES-ARI Phoenix Paleoecology Project provided information on long-term human and ecological responses to perturbations in climate at several spatial and temporal scales. Archaeologists in the Phoenix Basin area have documented significant cultural change for the prehistoric Hohokam between AD 900 and AD 1200, which marks a change from a politically more egalitarian Preclassic to a more hierarchically organized Classic Period. During the Preclassic, the Hohokam participated in a broad-scale ballcourt network, which spread from the Hohokam core area around Phoenix, to distant places across Arizona, from Tucson to Flagstaff. Archaeologists hypothesize that the ballcourt network served as an economic network redistributing spatially variable subsistence and nor-subsistence resources. By the end of the Preclassic Period, ballcourts were abandoned and a new form of public architecture emerged, the platform mound. Coinciding with the collapse of the ballcourt network was a contraction of regional interaction and the primary Hohokam settlements were in the Phoenix Basin.

Coincident with these regional cultural and economic transformations is a shift from spatially heterogeneous precipitation to spatially homogeneous precipitation

across the southwest US, as documented by tree-ring data. We hypothesize that this large-scale climatic change is the result of shifts in monsoonal patterns. Botanical remains from archaeological contexts provide an independent test of these climate changes. Furthermore, the observed cultural changes in the core and peripheral areas appear to be predictable responses to the observed climatic and resultant ecological changes.

Warren, Paige S.[1], Ann P. Kinzig[2,3], Mary Cox[4], J. Morgan Grove[5], Chris Martin[6], and Charles Nilon[7]. ***Human socioeconomic factors and avian diversity: A cross-site comparison***. [1]Biology Department, 2119 Derring Hall, VPI&SU, Blacksburg VA 24061; [2]Department of Biology, Arizona State University, Box 871501, Tempe, AZ 85287-1501; [3]Center for Environmental Studies, Arizona State University, Box 873211, Tempe, AZ 85287-3211; [4]Parks and People Foundation, Baltimore, MD 21211; [5]USDA Forest Service Northeast Research Station, Burlington, VT 05403; [6]Department of Plant Biology Arizona State University, Box 871601,Tempe AZ 85287-1601; and [7]Department of Fisheries and Wildlife, University of Missouri, Columbia, MO 65211.

A variety of measures have been advanced as predictors of ecological patterns in urban areas, such as human population density, building density, and canopy cover. These measures can be combined to describe the structure of urban patches within cities. However, these biophysical measures describe only a portion of the habitat structure that is important for wildlife such as birds. For example, neighborhoods with the same housing density can be landscaped with completely different kinds of plants. Thus, other tools are necessary in order to predict variation in the quality of habitat provided by these patches. In our studies of small, neighborhood parks in Phoenix, AZ, we found that the socioeconomic status (SES) of the neighborhoods around the parks was one of the best predictors of bird community structure within them. Socioeconomic differences can have strong consequences for the number of species and abundance of biota an area can support; human behaviors, values, and resource consumption levels can influence factors such as the habitat, food availability and predation rates for other organisms. We conducted point counts for birds in small neighborhood parks (<15 acres) falling along socioeconomic gradients in two cities: Phoenix (16 parks) and Baltimore (50 parks). Across two years of quarterly annual field surveys in Phoenix, we found that bird species richness was consistently strongly correlated with human SES. Preliminary data from the breeding season in 2002 in Baltimore shows a similar correlation between species richness and SES. An advantage of using SES's over direct measures of the factors influencing biotic communities is that information on SES is widely available. If this measure of human socioeconomic status can act as a surrogate for critical ecological conditions, then we can begin to predict species distributions in urban areas over broader geographic scales

Whitcomb, Sean, and Jean Stutz. ***Small-scale spatial patterns of arbuscular mycorrhizal fungal diversity in an experimental urban landscaped site***. Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

Soil microbes often exhibit strong spatial structuring at several scales, rendering random sampling techniques useless, yet no studies have examined spatial patterns of arbuscular mycorrhizal fungal (AMF) species at scales less than 50 m. In the current study, we hypothesized that AMF species richness and composition in an experimental urban landscaping site would exhibit non-random spatial patterns. Two 9.2 m x 9.2 m human-managed permanent long-term monitoring plots were established at the Desert Botanical Garden and were planted with woody plants typically used in xeric landscaping in Phoenix. Soil samples were taken at 25 points in each plot in a regular grid pattern and used to establish trap cultures. AMF spores were then extracted and identified. Species richness and composition patterns were examined with spatial statistics. Species richness varied from zero to six species per sampling point. Species richness values were negatively autocorrelated at a scale of <1.8 m, revealing a non-random distribution. Most individual species were randomly distributed, but one species in each plot was autocorrelated. These results indicate that traditional random or stratified random sampling methods may not truly capture the variability in AMF species richness and composition present in urban landscapes.

Whitcomb, Sean, and Jean Stutz. ***Pruning effects on root length density, root biomass, and arbuscular mycorrhizal colonization in two shrubs in a simulated xeric landscaped yard.*** Department of Plant Biology, Arizona State University, Box 871601, Tempe, AZ 85287-1601.

Although shoot pruning is a common landscape practice, little research has focused on its effects on the roots and mycorrhizal associations of woody landscape plants. In this study, we examine the effects of shoot pruning on root length density, root biomass, and arbuscular mycorrhizal (AM) colonization of two woody shrubs commonly used in xeriscape landscapes in the Phoenix metropolitan area, *Nerium oleander* and *Leucophyllum frutescens*. Seven experimental plots were established using landscape practices typical of arid, urban environments, including drip irrigation and decomposed granite mulch, and three pruning treatments were initiated (2 plots per treatment + 1 unpruned control plot). These treatments included 1) shearing every 6 weeks, 2) heading back every 6 months and 3) renewal pruning (cutting back to 0.5 m) every year. Roots were sampled at the base of three plants of each species by soil coring to a depth of 20 cm. The first root sampling occurred in the late winter, after the shearing and heading treatments had been imposed, but prior to the first renewal pruning. A second root sampling occurred during active growth in the late spring. The two species responded differently to pruning, and the effects varied depending on the date of sampling.