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

Second Annual Poster Symposium

January 19, 2000
Arizona Room, Memorial Union
Arizona State University

Sponsored by:
Center for Environmental Studies
Arizona State University

CAP LTER

Agenda

January 19, 2000

Arizona Room, Memorial Union

1:00 - 1:15 pm	Welcome and Introductions
1:15 - 1:35 pm	Keynote Address by Dr. Steward Pickett, Principal Investigator of the Baltimore Ecosystem Study, within the U.S. LTER Network
1:35 - 2:45 pm	Poster Session #1
2:45 - 3:00 pm	Break
3:00 - 4:00 pm	Poster Session #2
4:00 - 4:05 pm	Concluding Remarks
4:05 - 4:30 pm	Social with Refreshments

2000 CAP LTER Symposium

Poster Session 1 (1:35-2:45 PM; 17 posters)	Poster Session 2 (3:00-4:00 PM; 16 posters)
Blair, Taylor, and Brazel	McIntyre and Hostetler
Bolin, Hackett, Pijawka, Sadalla, Brewer, Matranga, and Sicotte	McIntyre, Rango, Fagan, and Faeth
Clark, Jenerette, and Rango	Mueller and Day
Compton, Hunter, and Sommerfeld	Nelson and Harlan
Cousins and Stutz	Nelson, Harlan, Hogan, Rex, Hackett, Bolin, Sadalla, Pijawka, Burns, and Kirby
Edmonds, Hope, and Grimm	Peterson and Martin
Elser and Williams	Peterson, Stabler, and Martin
Fergason, Arrowsmith, and Tyburczy	Ramirez, Wallace, Dryden, and Craig
Gries, Zhu, Hope, and Carroll	Reid, Hoppmann, Smith, Fry, and Redman
Grove, Pickett, and Burch	Roach, Coppola, Grimm, Hope, Jenerette, Luck, and Zhu
Honker	Stabler, Blank, Peterson, and Martin
Hope, Anderson, Grimm, and Boone	Stabler and Martin
Luck, Jenerette, and Grimm	Stefanov and Christensen
Martin, Blank, and Stabler	Stiles and Scheiner
Martin, Blank, Peterson, and Stabler	Ward-Rainey, Shi, and Rainey
Matranga, Bolin, Brewer, Hackett, Pijawka, and Sadalla	Wu
McCartney	

LIST OF POSTERS

Blair, John M., Matthew J. Taylor, and Anthony Brazel. ***Urban climate change: defining the magnitude of islands and oases.***

Bolin, Robert, Edward Hackett, David Pijawka, Edward Sadalla, Debbie Brewer, Eric Matranga, and Diane Sicotte. ***Environmental equity in a Sunbelt city.***

Clark, Kevin B., G. Darrel Jenerette, and Jessamy J. Rango. ***Heterogeneous urban landscape structural effects on desert remnant bird species assemblages in Phoenix, Arizona.***

Compton, Mark, Jennifer Hunter, and Milton Sommerfeld. ***Urban lakes – relationships between source water, lake age, water chemistry, and biota.***

Cousins, Jamaica R., and Jean C. Stutz. ***Arbuscular mycorrhizal fungal species composition, richness, and abundance in the Phoenix metropolitan area.***

Edmonds, Jennifer, Diane Hope, and Nancy Grimm. ***Spatial and temporal trends in surface waters moving through the Phoenix metropolitan area.***

Elser, Monica M., and Susan Williams. ***K-12 student contributions to the CAP LTER project.***

Fergason, Kenneth C., J Ramón Arrowsmith, and James A. Tyburczy. ***Changes of groundwater elevation associated with Tempe Town Lake.***

Gries, Corinna, Weixing Zhu, Diane Hope, and Steven Carroll. ***CAP LTER 'survey 200' update: first experiences and preliminary results.***

Grove, J. Morgan, Steward Pickett, and William R. Burch, Jr. ***The Baltimore Ecosystem Study: a patch dynamics approach to the study of urban ecological systems***.

Honker, Andrew M. ***Choices and consequences: an overview of Salt River flooding, 1891-present.***

Hope, Diane, James Anderson, Nancy B. Grimm, and Shawn Boone. ***Atmospheric deposition across the CAP ecosystem: some preliminary findings.***

Luck, Matthew, G. Darrel Jenerette, and Nancy B. Grimm. ***Scales of urban ecological interaction.***

Martin, Chris A., Joanne C. Blank, Kathleen A. Peterson, and L. Brooke Stabler. ***Urban land use affects landscape microclimate and CO_2 concentration.***

Martin, Chris A., Joanne C. Blank, and L. Brooke Stabler. ***A comparison of microclimate in residential landscapes.***

Matranga, Eric, Robert Bolin, Debbie Brewer, Edward Hackett, David Pijawka, and Edward Sadalla. ***Technological hazards in the Southwest: environmental equity and the demographics of risk.***

McCartney, Peter H. ***Building a network of environmental data resources for central Arizona***.

McIntyre, Nancy E., and Mark E. Hostetler. ***Effects of urban land use on Hymenopteran pollinator community structure in a desert metropolis.***

McIntyre, Nancy E., Jessamy Rango, William Fagan, and Stanley Faeth. ***Ground arthropod community structure in a heterogeneous urban environment.***

Mueller, Erin C., and Tad A. Day. ***Effects of urban ground cover on microclimate and landscape plant performance.***

Nelson, Amy, and Sharon Harlan. ***Labor market dynamics in a postindustrial city: a spatial and sectoral analysis of employment changes in the Phoenix MSA.***

Nelson, Amy, Sharon Harlan, Tim Hogan, Tom Rex, Edward Hackett, Robert Bolin, Edward Sadalla, David Pijawka, Elizabeth Burns, and Andrew Kirby. ***Phoenix area social survey.***

Peterson, Kathleen A., and Chris A. Martin. ***Construction of a questionnaire to examine the effects of socioeconomic factors on residential landscape plant preferences in communities with and without homeowners associations.***

Peterson, Kathleen A., L. Brooke Stabler, and Chris A. Martin. ***Irrigation application volumes in urban residential landscapes.***

Ramirez, L., John Wallace, K. Dryden, and Tim Craig. ***Impact of urbanization on an insect-plant interaction: bruchid beetles on blue palo verde.***

Reid, Eva C., Justin Hoppmann, C. S. Smith, Jana Fry, and Charles L. Redman. ***ASU CAP LTER historical land use study: Phase II.***

Roach, W. John, Aisha Coppola, Nancy B. Grimm, Diane Hope, G. Darrel Jenerette, Matthew Luck, and Weixing Zhu. ***Stream ecology in an urban environment: research opportunities in Indian Bend Wash, Scottsdale, Arizona.***

Stabler, L. Brooke, Joanne C. Blank, Kathleen A. Peterson, and Chris A. Martin. ***Spatial gradients of temperature and CO_2 concentration in metropolitan Phoenix.***

Stabler, L. Brooke, and Chris A. Martin. **Plant gas exchange in disparate land uses.**

Stefanov, Will L., and Philip R. Christensen. ***Comparison analysis of soil development on semiard hillslopes using linear deconvolution of Thermal Multispectral Scanner (TIMS) data.***

Stiles, Art, and Sam Scheiner. ***Plant community responses to habitat fragmentation within the Phoenix metropolitan area.***

Ward-Rainey, Naomi, Yanlin Shi, and Fred A. Rainey. ***Observing patterns of prokaryotic diversity along land use gradients of the CAP LTER.***

Wu, Jiango. ***Characterizing the spatial pattern of urban landscapes using a multiple scale approach: the effects of changing grain and extent.***

Blair, J. M., M. J. Taylor, and A. Brazel. ***Urban climate change: defining the magnitude of islands and oases.*** Department of Geography, Arizona State University, PO Box 870104, Tempe, AZ 85287-0104.

Desert cities may demonstrate a nocturnal urban heat island (UHI), as well as a day time oasis effect in which they are cooler than the surrounding desert. The type of rural site selected – whether desert or agricultural – is crucial to determining the magnitude of both heat island and oasis. This aspect of urban climate research has been alluded to in the literature, but little empirical work has been conducted regarding type of rural climate station to use as the benchmark. This paper shows that the definition of the term "rural" determines at least the magnitude and possibly the presence of the UHI and oasis in the Phoenix metropolitan area.

We examine the records of two desert and two agricultural climate stations. All are benchmarked against long-term data for the urban weather stations in Tempe, Mesa, Phoenix downtown and Phoenix Sky Harbor Airport. The work builds upon research recently completed by Brazel et al. (2000) for one of the desert weather stations. Data for the second desert station acts as a check on these findings. The analysis of both desert and agricultural benchmarks enable us to compare recent results and also broaden our understanding of the UHI and oasis phenomena.

We hypothesized that our data would confirm findings that suggest the UHI is a night-time phenomenon in metropolitan Phoenix; that the two agricultural benchmarks would diminish nocturnal UHI outcomes; and that the reduction of the heat island and similar behavior of the daytime temperatures when referenced to agricultural sites vs. desert sites is consistent with the theory of thermal admittance influences from the terrain. The data suggests that the hypotheses are correct.

Bolin, R.[1], E. Hackett[1], D. Pijawka[2], E. Sadalla[3], D. Brewer[4], E. Matranga[4], and D. Sicotte[1]. ***Environmental equity in a Sunbelt city.*** [1]Department of Sociology, Arizona State University, PO Box 872101, Tempe, AZ 87287-2101; [2]School of Planning and Landscape Architecture, Arizona State University, PO Box 872005, Tempe, AZ 85287-2005; [3]Department of Psychology, Arizona State University, PO Box 871104, Tempe, AZ 85287-1104; [4]Department of Geography, Arizona State University, PO Box 870104, Tempe, AZ 85287-0104.

We mapped the spatial and social distributions of industrially generated airborne hazards in the Phoenix metropolitan area, using data from the EPA's Toxic Release Inventory (TRI) and the U.S. Census. Neighborhoods that contain TRI facilities have lower average household incomes, lower housing values, lower rent, and higher proportions of ethnic minority population. The aggregate volume of releases, measured in pounds, is also significantly related to the income level and ethnic composition of the neighborhood. When volume of releases is weighted by a measure of toxicity, however, the relationship to socioeconomic and ethnic characteristics changes. Facilities emitting high levels of weighted releases tend to be high-tech industries located in white, middle class neighborhoods.

Clark, K. B., G. D. Jenerette, and J. J. Rango. ***Heterogeneous urban landscape structural effects on desert remnant bird species assemblages in Phoenix, Arizona.*** Department of Biology, Arizona State University, PO Box 871501, Tempe, AZ 85287-1501.

Within the city of Phoenix, Arizona, a series of isolated desert habitats has been preserved. These desert remnants are inhabited by unique assemblages of bird species. Although island biogeographic and habitat diversity approaches help explain some aspects of these remnant communities, unexplained variation still remains. This project examines the degree and manner in which neighboring urban landscape structure affects summer bird species assemblages at 11 study sites (8 desert remnants and 3 desert controls). We hypothesize that richness, evenness, and diversity of bird communities on desert remnants will be impacted by surrounding landscape structure. Specifically, we predict that increases in landscape structural complexity will lead to increases in bird community richness, evenness, and diversity. To test our hypothesis we regressed three community metrics (richness, evenness, and diversity) against several landscape structural variables (e.g., patch density, patch richness, edge density, contagion, and proportion of specific land use types) at five distance ranges (100 m, 250 m, 500 m, 1000 m, and 2500 m) surrounding each desert remnant. Preliminary results indicate that patch richness, patch number and patch size of surrounding landscape significantly influence the three community metrics tested. The influence varies, however, dependent on which scale of analysis is used. These results suggest that independent of the land use classes surrounding a desert remnant, the structure of the inter-patch matrix is an important determinant of bird assemblage.

Compton, M., J. Hunter, and M. Sommerfeld. ***Urban lakes – relationships between source water, lake age, water chemistry, and biota.*** Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601.

More than 50 urban lake systems exist in Maricopa County. Urban lakes were created to serve recreational, aesthetic, and flood control purposes, and were generally constructed in an opportunistic manner whenever water rights could be secured. Although individual lake owner's associations have conducted some level of aquatic monitoring over the years, little effort has been made to bring preexisting data sets together or to systematically investigate the lakes. The objective of this study was to determine how water chemistry, primary production, and algal populations in urban lakes are related to lake age, water source, and other lake characteristics. To achieve the objectives of this study six urban lakes were selected to maximize variations in age and water source (canal, well, and effluent). Monthly water sampling, over the course of 1999, examined a variety of physico-chemical parameters, including major ions, nutrients, selected metals, and organics. Water samples were also examined for algal biomass and species composition. Selected data will be presented to compare aspects of the biology and chemistry for the six lakes.

Cousins, J. R., and J. C. Stutz. ***Arbuscular mycorrhizal fungal species composition, richness, and abundance in the Phoenix metropolitan area.***
Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85208-1601.

Mycorrhizal fungi are a key functional group found in soil, forming symbiotic relationships with plant roots. Little is known about arbuscular-mycorrhizal fungi (AMF) in urban environments. As urban areas increase in size and number, there is a growing need for research to understand AMF diversity and functioning in these systems. Detection of spores present in the soil is one way to estimate the diversity of AMF species. This project sought to characterize AMF species composition, richness, and abundance at 20 sites located in the Phoenix valley. Sites were randomly chosen as part of the CAP LTER 200 Points Pilot Survey conducted in May of 1999. Three soil samples were collected at each site. Sites were placed into one of six categories: agricultural, commercial, desert, desert/transition, residential, and vacant lots. Spores were extracted from 100 cm^3 soil samples, counted, mounted on slides, and examined using the light microscope for species identification. Agricultural, commercial, desert, and desert/transition sites had the highest spore abundance, while abundance at residential and vacant lot sites was significantly lower. Highest species richness was found at agricultural, commercial, desert/transition, and residential sites. Significantly lower species richness was found at desert sites and the least at vacant lot sites. Fourteen species were identified in the study, with 11 from the genus *Glomus*, 2 from *Acaulospora*, and 1 from *Entrophospora*. Two undescribed *Glomus* species were detected. The establishment of trap cultures is currently underway and will provide additional information about the species present at the 20 sites.

Edmonds, J.[1], D. Hope[2], and N. Grimm[1]. ***Spatial and temporal trends in surface waters moving through the Phoenix metropolitan area***. [1]Department of Biology, Arizona State University, PO Box 871501, Tempe, AZ 85287-1501; [2]Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211.

The surface water monitoring project associated with the CAP LTER has been in place since February 1998. The LTER sites and sampling protocol build on the 1995-1997 NAWQA USGS program that sampled surface waters flowing into and exiting the city of Phoenix (essentially along a desert to urban gradient). The congruency in design allows researchers to combine the USGS data with data collected by the CAP LTER, extending the temporal record at each site and analyzing the time series in cooperation with the USGS Tempe office. The objectives of the project are to initiate and develop a field sampling program designed to answer the following questions: (1) What are the concentrations and amounts of key nutrients, salts, and trace metal being imported to and exported from the CAP LTER urban areas in surface water (river and canal)? (2) How do these terms change over time in response to increasing urbanization and variations in climate?

Seven sites, each at a USGS gauging station, are sampled frequently; three east of the city, three within the city, and one at the hydrologic output of the city. Nitrogen and carbon fluxes at each site have been calculated by multiplying daily discharge (volume of water passing a point along the stream) by concentration of the chemical constituent of interest. Data analysis to date indicates that waters entering the city are variable in salt concentrations, have a pH around 8, are low in nutrients, metals, and particulate material, and have moderate concentrations of dissolved organic carbon (DOC). Water discharged from the 91st Ave treatment plant (one of the three mid-city sites) flows downstream for almost 60 kilometers to the Gila River. These mid-city waters (along the native desert to urban gradient) have even higher salt concentrations than the input waters, and are higher in organic and inorganic nutrients and DOC. Concentrations in the Gila River water at Gillespie Dam (the output to the whole metro system) are higher than input concentrations for all chemical constituents measured. A study is beginning in January 2000 to explore the mechanisms that could be responsible for dramatic change in water quality along this urban stream. The challenge is to begin to distinguish between urban and agricultural inputs to surface waters measured by the LTER. Data analysis suggests that the location of engineered features and agricultural inputs determines the longitudinal pattern of change in water chemistry as water moves through the city.

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

Students from across the Phoenix metropolitan area have been involved in collecting population data in their schoolyards. Highlighted here are projects that will be represented at the CAP LTER poster symposium.

From: Meyer Elementary School, Susan Huffakar, third grade teacher. Students mapped and researched the local history of their school. They are learning to identify arthropods and are contributing data as well as pictures.

From: Hendrix Junior High, Larry Langstaff, eighth grade teacher, Cyle Weaver, student presenter. Students at Hendrix Junior High have been collecting arthropod data on two contrasting sites in their schoolyard. One is a grassy playing field, the other is a dry dirt lot that will be converted to a desert habitat by the end of spring semester.

From: Machan Elementary School, Renee Bachman sixth grade teacher. Students from Machan have been surveying birds at various sites in the schoolyard and will be presenting their data with associated habitat information.

From: Lowell Elementary School, Paula Beacom, seventh grade, lead teacher. Students from Lowell have collected data on the bruchid beetle populations on their schoolyard palo verde trees. They will be presenting their data.

Fergason, K. C., J R. Arrowsmith, and J. A. Tyburczy. ***Changes of groundwater elevation associated with Tempe Town Lake.*** Department of Geology, Arizona State University, PO Box 871404, Tempe, AZ 85287-1404.

The construction, filling, and management of Tempe Town Lake in the alluvium-filled Salt River channel have influenced the elevation of the water table proximal to the lake. A goal of the City of Tempe is to create this lake while losing as little water as possible to the subsurface (i.e., not to influence the elevation of the water table). Both the City of Tempe and we have monitored well levels at 19 different well locations surrounding Tempe Town Lake for the past 2 years. Prior to the filling of the lake, water table elevation ranges were dependent upon the presence of water in the Salt River. Groundwater elevation highs occurred during or following the presence of water in the channel, and lows occurred during periods of no flow. Since the filling of the lake, water table elevations have been dependent upon the water retention and recovery activities associated with the lake operation. The City of Tempe has three primary methods for limiting water loss: (1) slurry walls, (2) clay liner, and (3) recovery wells. The intent of the slurry walls and clay liner is to reduce water loss, while the recovery well system captures lost water and returns it to the lake. Well level data were compiled in relation to their distribution through time and space. Linear interpolation was used to find elevations at dates when data were not available. The data were gridded, and the results have been visually displayed as a 3-D surface evolving over time. Initially the elevation of the water table increased by several feet, especially in the upstream vicinity of the lake (roughly 0.6 feet per day for the first 10 days). The downstream end of the lake showed a steady increase through the first 40 days (at a rate of approximately 0.15 feet per day) that has now leveled out to fairly constant elevations. At the upstream portion of the lake however, water table elevations are dependent upon operation of the recovery wells, and were actually seen to decrease post filling by up to 10 feet from the initial rise (to approximately 5 feet below levels prior to lake filling). It appears that the city may be unintentionally lowering the water table below the upstream end of Tempe Town Lake.

Gries, C.[1], W. Zhu[1], D. Hope[1] and S. Carroll[2]. ***CAP LTER 'survey 200' update: first experiences and preliminary results***. [1]Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; [2]Department of Biology, Arizona State University, PO Box 871501, Tempe, AZ 85287-1501.

An update on the extensive Central Arizona - Phoenix LTER sampling of 200 points within the study area will be given. The goal is to monitor long-term ecological trends in time and space. Using a tessellation-stratified approach 200 sample points have been placed within the CAP LTER area. A grid of 4 x 4 km was constructed over the urban core and desert fringe. Within the urban core one sample point (ea) was randomly located per grid cell and in the desert fringe one per three grid cells. Plots were circular and 900 m^2 in size. Protocols for sampling of land cover, land use, plant survey, soil chemistry and texture, mycorrhizal status and bacterial diversity, litter and wood decomposition rate, bird and arthropod diversity, human activities and meso/microclimate were developed by the CAP LTER PIs. An initial pilot phase of sampling at 20 representative sites was undertaken in April/May 1999, in order to test the field protocols and data handling procedures. Main sampling will take place in spring of 2000 and then every 3 to 5 years thereafter. Preliminary findings indicate a number of trends. The percentage of non-native plant species in residential yards in the Phoenix metropolitan area appear to be higher than in temperate European cities. Shrub biomass per unit area in the desert exceeds that in residential yards, while tree biomass is higher in the residential yards. Extractable NO_3-N varied by a factor of 500 in surface soils from the pilot plots, with highest concentrations in sites close to the urban center (particular at unvegetated sites close to busy roads), low-to-moderate concentrations in residential and agricultural sites and lowest concentrations in outlying desert sites.

Grove, J. M.[1], Steward Pickett[2], and W. R. Burch, Jr.[3]. ***The Baltimore Ecosystem Study: a patch dynamics approach to the study of urban ecological systems***.
[1]USDA Forest Service, Northeastern Research Station, 705 Spear St, South Burlington, VT 05403; [2]Institute of Ecosystem Studies, Box AB (Route 44A), Millbrook, NY 12545-0129; [3]School of Forestry and Environmental Studies, Yale University, Sage Hall, 205 Prospect Street, New Haven, CT 06511

This study examines the nature and types, pattern and processes of urban ecosystems. Urban ecosystems are anthropogenic dominated; relatively densely settled; and concentrated compositions of human populations, biophysical elements, and infrastructural components. This study will identify, describe, measure, analyze, and develop predictive capability regarding the critical interactions between biophysical, infrastructural, and sociocultural elements affecting urban ecosystems. Four types of analytical approaches will guide this research: (1) The human ecosystem framework (descriptive analysis); (2) units of organization, scale and hierarchy (structural analysis); (3) temporal and spatial dimensions of homogeneity and heterogeneity at different scales (pattern analysis); and (4) demographic and symbolic change over time (process analysis). These approaches are interdisciplinary in that comparable units of analysis, measures, and concepts guide the core studies of all the scientific domains represented in the BES. Ultimately, the goal is to develop a more robust and unified biosocial ecology set of theories, methods, and understandings.

Honker, A. ***Choices and consequences: an overview of Salt River flooding, 1891-present.*** Department of History, Arizona State University, PO Box 872501, Tempe, AZ 85287-2501.

The idea of flooding in the desert metropolis of Phoenix may seem incongruous, especially when one considers that the average rainfall in the Phoenix area is less than eight inches a year. Yet, since the city was founded in 1867 its residents have had to contend with periodic flooding. Particularly damaging have been floods on the Salt River, which runs through the middle of the Phoenix metropolitan area. The largest flood in the historic record stuck the Phoenix area in February 1891, causing widespread damage and leaving the city without a rail connection for three months. Even with this recent flood, however, it was drought that Valley leaders looked to combat as they pushed for a large-scale water storage dam on the Salt River. When Roosevelt Dam was completed in 1911 its intent and design were for water storage and not flood control. The same is true for the other five dams on the Salt and Verde Rivers. By storing the water of the Salt upstream and diverting it into canals in the eastern part of the Valley, city leaders made the choice to eliminate a flowing Salt River through the Phoenix metropolitan area. This choice has led to unintended consequences. Even though the dams and reservoirs on the Salt River are not designed or operated for flood control, they do provide some measure of protection for the Phoenix area under most conditions. Because of this protection, and because most people associate the Salt River with the dry, dusty channel that snakes its way through the Valley, the majority of Valley residents fail to perceive the continued threat of flooding on the Salt. Thus, the elimination of the river and the series of impressive dams on the Salt and Verde have created an illusion of protection. The elimination of the river also changed how Valley residents viewed the Salt River and its floodplain. In the past, when the Salt River flowed perennially in its banks, people in the Valley were cautious about building too close to the river. Once water was removed from the river this attitude slowly changed. The dry bed of the Salt River no longer seemed part of a living, natural system, rather it gradually became viewed as wasted land, as an area that could and should be used and developed. So, Valley residents began to build in the river and on its floodplain, and they also paid less attention to the structural integrity of things built in the riverbed like bridges. Although the river was gone, however, floods were not, and the conflict between the continued reality of flooding and the changing perception and use of the dry Salt River and its floodplain lay at the heart of the history of Salt River flooding over the past 50 years. The floods of 1979-80 and 1993 highlighted several results of this conflict. The extensive damage of these floods, along with the public reaction to the floods, showed what could happen when a very real flood burst through the Valley's illusion of protection. The risk involved in placing buildings in the riverbed and floodplain has led and will continue to lead to problems until flooding is eliminated (which is a difficult if not impossible task) or public perceptions and attitudes towards the Salt River change.

Hope, D.[1], J. Anderson[2], N. B. Grimm[3,] and S. Boone[4]. ***Atmospheric deposition across the CAP ecosystem: some preliminary findings.*** [1]Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; [2]Department of Biology, Arizona State University, PO Box 871501, Tempe, AZ 85287-1501; [3]Department of Mechanical and Aerospace Engineering, Arizona State University, PO Box 876106; [4]Texas A & M, Corpus Christi, TX.

Man is increasingly affecting biogeochemical cycling. This is particularly so in cities where nutrient and material fluxes, as well as the relative importance of transport and storage mechanisms, may be significantly modified with respect to less human-impacted ecosystems. Recent CAP LTER research has shown that for nutrients such as nitrogen, atmospheric deposition (wet and dry) potentially represents one of the largest inputs to the ecosystem, largely via NOx emissions in vehicle exhausts. However few empirical measures of nutrient deposition rates in cities have been made in the US, since most existing national monitoring networks such as the National Atmospheric Deposition Program and NOAA's AIRMON program consist of sites which are located almost exclusively in pristine natural areas, remote from urban influences. Hence atmospheric transport and deposition of nutrients and other ions, along with the effect of that deposition on biogeochemical cycling and ecosystem function in cities and surrounding ecosystems is currently only poorly understood.

The aims of the atmospheric deposition research at CAP LTER are to (i) develop a monitoring network to quantify the spatial variation and overall rates of atmospheric deposition for the major nutrients and ions across the city, (ii) determine the role of atmospheric deposition in urban biogeochemical cycling, and (iii) understand how atmospheric deposition interacts with and affects the functioning of other urban ecosystem processes, such as primary productivity. A network of wet/dry bucket collectors installed at nine sites across the CAP study area is described. Preliminary data on deposition rates of major nutrients in wet and dry deposition from the first 6 months of sampling will be presented. A field campaign to characterize the major ion chemistry of aerosols at 3 sites across the Valley using Particle Induced X-ray Emission (PIXE) during the summer of 1999 will also be described and the conclusions from this study regarding the main sources of aerosols contributing to dry deposition across the CAP site will be presented.

Luck, M., G. D. Jenerette, and N. B. Grimm. ***Scales of urban ecological interaction.***
Department of Biology, Arizona State University, PO Box 871501, Tempe, AZ 85287-1501.

How can reciprocal interactions between human and ecological processes be identified? We have developed a conceptual model of urban-ecological feedbacks, the Human Funnel Model (HFM), which addresses this question. The activities of human inhabitants of a city create a funnel into which resources are concentrated from a broader available pool of resources. The HFM suggests that the relevant socioeconomic scales are those at which ecosystem services are appropriated by a city. In order to quantify the scale of ecological feedbacks to urban systems, the ecological footprint has been used as a method for determining the land area required to support human consumption and to absorb urban wastes. We addressed several shortcomings of the ecological footprint concept and developed a modified, spatially explicit version to calculate the extent of interaction between the Phoenix metropolitan area and the appropriated land area independently for food and water resources. This was determined both for current and projected urban needs. Food and water showed different patterns of response to increasing growth. Spatial heterogeneity caused a non-linear relationship between the scale of resource appropriation and the amount of urban resources required.

Martin, C. A., J. C. Blank, K. A. Peterson, and L. B. Stabler. ***Urban land use affects landscape microclimate and CO_2 concentration***. Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601.

Urban areas are composed of a heterogeneous patchwork of disparate land use types. In the Central Arizona - Phoenix area, the relative proportions of plant cover to anthropogenic surfaces and associated differences in hydrology and water inputs via irrigation can be expected to influence local microclimate. Higher concentration of auto emissions associated with congested urban and commercial areas, as well as reduced plant canopy, might also be expected to produce pockets of high atmospheric CO_2 concentration associated with those land uses. During June 1999, five transects in the Central Arizona-Phoenix area, chosen to include patches of various urban land uses, were evaluated for spatial and temporal variation in microclimate and ambient carbon dioxide concentration. Microclimate parameters measured were air temperature (T_a) and per cent relative humidity (RH). From these data dew point temperature (DP), and vapor pressure deficit (VPD) were calculated. Microclimate measurements were recorded at approximately 175-m (0.1-mile) intervals using a Campbell Scientific 21x data logger. Air temperature measurements were made using a shielded copper constantan thermocouple wire mounted on a mobile unit at 0.5 and 5.0m and at 2m in conjunction with RH sensor. Atmospheric CO_2 was measured approximately every 350 m (0.2 miles) at a height of 2.5 m using a Li-Cor 6250 infrared gas analyzer (IRGA) in open system mode. Measurements were around 0500 and 1500 HR on days when weather conditions were clear and calm. Generally, T_a and DP were lowest in agricultural or residential areas and highest in commercial zones, while RH and VPD were highest and lowest in those two land uses, respectively. Degree of microclimate variation was greater during the early morning than during the afternoon. Differences in CO_2 concentration appeared to be unrelated to land use. These data suggest that under summer conditions, differences in plant canopy area associated with land use might affect landscape microclimate but not local CO_2 concentrations.

Martin, C. A., J. C. Blank and L. B. Stabler. ***A comparison of microclimate in residential landscapes.*** Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601.

Our objective was to investigate effects of land-use history and landscape design on plant canopy level microclimate in residential neighborhoods. We monitored air (T_{air}), leaf(T_{leaf}) and soil temperature (T_{soil}), relative humidity (RH), and net radiation (R_{net}) fluxes continuously for one year at four residential landscapes (less than 10 years old) in south Tempe and Ahwatukee Foothills of the greater Phoenix metropolitan area. Before being residential landscapes that are now either xeric or mesic in design, these sites had either a formerly desert or agricultural land-use history. All microclimate variables were measured every 5 min and means recorded every 30 min using a Campbell Scientific data loggers. Air temperature and humidity were measured at 0.5 m above the ground. Soil temperature was measured at a depth of 0.1 m. Leaf temperatures were measured at 0.5 m above ground on the abaxial surface of a shrub leaf. Net radiometers were mounted at 1.75 m above the ground to encompass approximately a 15-m diameter area. Interactive effects for T_{leaf} were seen throughout the year, with highest values in the formerly desert xeriscape and lowest values in the formerly desert mesiscape. The same pattern was seen for T_{soil}, except that main effects and no interaction occurred during July, August, and September, with hotter soils in formerly agricultural lands and xeriscapes. Net radiation differed only from November through January, with the highest fluxes occurring in the formerly agricultural xeriscape, a plot with extensive anthropogenic surface area. Although comparisons of T_{air} and RH were problematic due to a short-term equipment failure, in general T_{air} did not differ and RH showed interactive effects with highest values in the formerly desert mesoscape and lowest in the formerly desert xeriscape. These data suggest that plant physiological function might be more impacted by landscape design in formerly desert sites near South Mountain Desert Preserve than in formerly agricultural sites in lower terrain.

Matranga, E. [1], B. Bolin[2], D. Brewer[3], E. Hackett[2], D. Pijawka[4], and E. Sadalla[5].
Technological hazards in the Southwest: environmental equity and the demographics of risk. [1]Department of Geography, Arizona State University, PO Box 870401, Tempe, AZ 85287-0401; [2]Department of Sociology, Arizona State University, PO Box 872101, Tempe, AZ 85287-2101; [3]Department of Environmental Resources, Arizona State University East, 6001 E. Power Rd, Mesa, AZ 85206; [4]School of Planning and Landscape Architecture, Arizona State University, PO Box 872005, Tempe, AZ 85287-2005; 5Department of Psychology, Arizona State University, PO Box 871104, Tempe, AZ 85287-1104.

We examine the spatial distribution of large quantity generators of hazardous chemicals in Arizona, California, Colorado, New Mexico, Nevada, Texas, and Utah using the EPA's Toxic Release Inventory. The research maps, the numbers of facilities, and total volumes of toxic emissions by county and zip code for each state against the demographic composition of those spatial units. At issue is whether counties and zip codes with above average numbers of Hispanics, African Americans, and low income residents have inequitable numbers of TRI facilities and volumes of releases of toxic chemicals. Previous research by the authors shows that Phoenix has distinct patterns of environmental inequities with Latinos and African-American neighborhoods having disproportionate *numbers* of toxic facilities and having disproportionate *quantities* of toxic substances released into the atmosphere. This study examines whether the patterns that pertain in Phoenix reflect regional urban patterns in the distribution of technological hazards in minority and low income communities. A key concern is whether the urban ecology of Sunbelt cities is associated with the inequitable spatial allocation of technological hazards. The research uses t tests to determine statistical significance of demographic differences of spatial units with and without TRI facilities. Correlations are utilized to assess the relationships between total volume (by tons) of emissions and the socio-demographic composition of counties and zip codes. Comparisons of the states are presented to assess intra-regional differences.

McCartney, P. H. ***Building a network of environmental data resources for central Arizona.*** Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211.

Among the most significant products of the CAP LTER project are the longitudinal databases produced by monitoring studies. Managing, preserving, and providing user-friendly access to the ever-growing mass of environmental data that is now available through government agencies, remote sensing, and grant-funded research has become one of the most significant challenges for the next century. This poster illustrates how a diverse array of data resources from ASU research are being integrated and made accessible through computer networks and explains some of the advances in information technology that are making environmental data more readily available to research, education and conservation.

McIntyre, N. E., and M. E. Hostetler. ***Effects of urban land use on Hymenopteran pollinator community structure in a desert metropolis.*** Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211.

We compared the community structure (species richness and abundance) of Hymenopteran pollinators (bees) in two seasons (late summer 1998 and spring 1999) among four types of urban land use in the Phoenix, Arizona, metropolitan area (xeriscaped residential yards, mesiscaped residential yards, urban desert-remnant parks, and natural desert parks on the fringe of the metropolitan area). Both richness and abundance of pollinators were lower in residential areas than in desert areas, and desert areas on the fringe of the city possessed the highest diversity of all sites. Residential yards that utilized xeric landscaping were richer in bees than were mesic turf yards. These results indicate that urban development can be designed to promote the conservation of Hymenopteran pollinators. Preservation of desert and greater use of xeric landscaping rather than mesiscaping will help preserve this ecologically and economically important group of organisms.

McIntyre, N. E. [1], J. Rango[2], W. Fagan[2], and S. Faeth[2]. ***Ground arthropod community structure in a heterogeneous urban environment***. [1]Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; [2]Department of Biology, Arizona State University, PO Box 871501, Tempe, AZ 85287-1501.

The richness and abundance of ground arthropods were systematically monitored for 12 months at 16 sites in the Phoenix, Arizona, metropolitan area. These sites represented four types of urban land use, including residential, industrial, agricultural, and desert remnant. There were significant differences in arthropod diversity among the four land-use types, with the most taxa found at agricultural sites and the least taxa occurring at industrial sites. Canonical correspondence analysis revealed that arthropod community composition varied with land use, corresponding to differences in habitat structure (percent horizontal ground cover of a variety of anthropogenic and natural structures). Predators, herbivores, and detritivores were most abundant in agricultural sites, whereas omnivores were equally abundant in all forms of land use. There were pronounced seasonal effects with a marked decrease in richness and abundance of ground arthropods in cooler months. Richness tracked temperature but not precipitation (possibly due to the high variability associated with rainfall events in the Sonoran Desert). As part of an ongoing monitoring effort, these results will be useful in predicting effects on biodiversity from future urban development. In particular, our results indicate that the spatial heterogeneity of land use in the Phoenix area promotes biotic diversity.

Mueller, E. C., and T. A. Day. ***Effects of urban ground cover on microclimate and landscape plant performance.*** Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601.

In order to better understand the relationship between urban ground cover, microclimate, and landscape plant performance, we constructed four different ground cover type plots during the summer of 1998: (1) mesoscape (well-irrigated turf), (2) xeriscape (crushed river rock), (3) concrete, and (4) asphalt. Potted oleander plants (*Nerium oleander*) were placed in the center of each cover type plot. We studied plants in the plots over two contrasting growing periods: fall/winter (September 1998-February 1999) and spring/summer (March-September 1999). The performance of oleander plants in the center of each plot was assessed with monthly measurements of growth, net photosynthesis and dark respiration rates, and final biomass was determined during February and September harvests. The microclimate in each plot was characterized by monitoring oleander canopy air temperature and relative humidity, soil temperature, cover type surface temperature, and incoming and outgoing radiation. During both growing seasons, daytime canopy air and soil temperatures and air vapor pressure deficits (VPD) were lowest in the mesoscape and highest in the xeriscape. Nighttime temperatures and VPD were lowest in the mesoscape and highest in the asphalt cover type. Microclimate differences among the treatments declined from September through January as seasonal air temperature declined, and increased again from March through August. Rates of net photosynthesis of all plants decreased through mid-summer, from June through July, and tended to be highest in plants in the cooler mesoscape cover type. Higher rates of net photosynthesis were particularly evident in mesoscape plants during periods of water stress. Mesoscape plants had lower relative growth rates (RGR) and produced less total biomass than plants in the other three cover types during the fall/winter season, and lower temperatures in the mesoscape in late December led to severe freeze damage. In contrast, plants in the mesoscape had higher RGR and produced more total biomass than plants in the other plots during the spring/summer growing season. These results illustrate that urban ground cover type and the resulting microclimate can have large impacts on the performance of surrounding vegetation. Furthermore, these influences are season specific; while cooler cover types such as mesoscapes may improve plant performance during warm seasons, they can also lead to decreased productivity and frost and freeze damage during cold periods in winter.

Nelson, A.[1], and S. Harlan[2]. ***Labor market dynamics in a postindustrial city: a spatial and sectoral analysis of employment changes in the Phoenix MSA.*** [1]Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; [2]Department of Sociology, Arizona State University, PO Box 872101, Tempe, AZ 85287-2101.

This study will investigate the effects of long-term labor market changes in the United States on gender, social class, and racial/ethnic inequalities in urban areas. The economic changes under study are: (1) economic restructuring, which social scientists define as the loss of manufacturing jobs and an increase in service jobs; and (2) spatial relocation of jobs within a metropolitan area. Outcome variables are employment indicators for different social groups and social and economic conditions in urban neighborhoods. The study will focus on the Phoenix Metropolitan Statistical Area (MSA) to represent economic expansion in Sunbelt cities. In the future, we will apply the results to a comparative project using the Baltimore MSA to represent the economic decline of manufacturing typical of Eastern cities. Data sets from three federal agencies for a 15-year period will be linked to develop area economic profiles, including the location and gender/racial composition of occupations in individual firms, wages for occupations in each area, and social indicators on urban neighborhoods where employers are located. Statistical techniques used to analyze the data will be based on multiple regression and logistic regression estimation procedures. The study will address the concerns of many social scientists that the current economic prosperity enjoyed in America is not being shared equally by all segments of society.

Nelson, A.[1], S. Harlan[2], T. Hogan[3], T. Rex[3], E. Hackett[2], R. Bolin[2], E. Sadalla[4], D. Pijawka[5], E. Burns[6], and A. Kirby[7]. ***Phoenix area social survey.*** [1]Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; [2]Department of Sociology, Arizona State University, PO Box 872101, Tempe, AZ 85287-2101; [3]Center for Business Research, Arizona State University, PO Box 874406, Tempe, AZ 85287-4406; [4]Department of Psychology, Arizona State University, PO Box 871104, Tempe, AZ 85287-1104; [5]School of Planning and Landscape Architecture, Arizona State University, PO Box 872005, Tempe, AZ 85287-2005; [6]Department of Geography, Arizona State University, PO Box 870104, Tempe, AZ 85287-0104; [7]Department of Social and Behavioral Sciences, Arizona State University West, 4701 W Thunderbird Rd, PO Box 33501, Phoenix, AZ 85069-3051.

People have profound impacts on the natural environments where they live and work. In rapidly growing, urbanized areas, such as Phoenix and the cities spreading around it, the land, air, habitats, and natural resources are subjected to many stresses from an increasing, diverse, and mobile population. At the same time, people are directly affected by the ecosystem. Individuals are born into existing environmental and social structures that both constrain and guide their experiences, values, attitudes, and behaviors. Ultimately, physical and social environments impact quality of life. Individuals in turn, perpetuate the existing system or alter the system in some way through their actions. As a result, people and their social and ecological environments exist in a feedback loop in which human action affects the physical landscape, which, in turn, affects people's experiences and the larger social structure.

Our main objective in the proposed research is to study the reciprocal relationships, or the interplay, between the social and natural environments in an urban ecosystem. In order to understand this complex process, LTER social scientists propose to conduct a large-scale, longitudinal survey of residents in the Phoenix-Mesa MSA. The social survey will measure the social ties of individuals to their community, values and sentiments regarding social responsibilities, behaviors that affect the natural environment, and satisfaction with the quality of life in the area. Our central research question asks how social ties, values, and behaviors are connected with one another in ways that reflect willingness to act socially and politically with respect to the environment, and how changing environmental conditions, in turn, affect the quality of human life.

Peterson, K. A., and C. A. Martin. ***Construction of a questionnaire to examine the effects of socioeconomic factors on residential landscape plant preferences in communities with and without homeowners associations.*** Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601.

Rapid population growth in Phoenix has resulted in a proliferation of new residential communities at the urban fringe. Large amounts of revenue and space are being allocated to landscaping in these residential locales. Unlike native vegetation, residential landscapes are under the complete control of humans. Landscaping in many of these new residential developments is sharply limited by homeowner association covenants, codes, and restrictions (CC&R's). The objective of our research is to study the effect of socioeconomic behaviors on vegetation patterns in residential communities with or without CC&R's regulating landscape practices. A mail survey with questions designed to elucidate homeowner landscape plant preferences and activities in residential communities with or without CC&R's was sent to 1,800 homeowners in new (post 1985) residential communities around the urban fringe of the Phoenix metropolitan area. A reminder post card and follow-up survey were sent which resulted in a response rate of 53%. In the future, we plan to characterize vegetation patterns in these residential locales. Analysis of our data coupled with public tax assessor's and census data will provide new relationships to better understand the form and function of residential landscapes.

Peterson, K. A., L. B. Stabler, and C. A. Martin. ***Irrigation application volumes in urban residential landscapes.*** Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601.

Ecological concerns about sustainability of Sonoran Desert cities have prompted many municipalities to promote water conservation through landscape design. In central Arizona urban residential landscapes containing desert-adapted plant species are termed xeriscapes™, while those containing temperate or tropical species and turf are termed mesiscapes. Monthly irrigation application data were collected from three xeriscape and three mesiscape residential landscapes of similar age in south Tempe and Phoenix suburbs for 16 months. Overall, landscape irrigation application volumes were about 1.5 times higher in summer than in winter, while homeowners irrigated xeric landscapes with 1.3 times more water than mesic landscapes. Variation in landscape irrigation application volumes between individual residences was greater for yards with xeric rather than mesic designs.

Ramirez, L., J. Wallace, K. Dryden, and T. Craig. ***Impact of urbanization on an insect-plant interaction: bruchid beetles on blue palo verde***. Department of Life Sciences, Arizona State University West, 4701 W. Thunderbird Rd, PO Box 32352, Phoenix, AZ 85069-2352.

We investigated the relationship between oviposition preference and offspring performance in two bruchid beetles, *Mimosestes amicus* and *M. ulkei* (Coleoptera: Bruchidae) on *Cercidium floridum*. We are studying the impact of urbanization on the relationship of the bruchid beetles and their host plants. We tested two hypotheses (1) that the *Mimosestes* beetles will show a preference for pods from the urban environment in choice experiments; (2) the performance of the *Mimosestes* larva will be higher on urban pods than on the desert pods. In both the field and laboratory choice experiments the data suggests that *Mimosestes amicus* have a preference for urban pods of *Cercidium floridum*. In the choice experiments the preliminary data has shown no correlation between oviposition preference and offspring performance. Based on the preliminary evidence we suggest that oviposition preference does not lead to increased offspring performance. This also implies that the differences in the population densities of the bruchid beetles between the desert and urban sites are due to the behavioral choices by the beetles and is not due to differences in host plant quality.

Reid, E. C.[1], J. Hoppmann[2], C. S. Smith[3], J. Fry[3], and C. L. Redman[4]. ***ASU CAP LTER Historical land use study: Phase II.*** [1] Department of Geography, Arizona State University, PO Box 870401, Tempe, AZ 85287-0401; [2]School of Planning and Landscape Architecture, Arizona State University, PO Box 872005, Tempe AZ 85287-2005; [3]Information Technology, Arizona State University, PO Box 870101, Tempe, AZ 85287-0101; [4]Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211.

The goal of the ASU CAP LTER Historical Land Use Study is to collect and map detailed land use data for individual study sites, approximately 1 mi^2 (2.6 km^2) in area. The goal of Phase II is to collect data for 20 pilot sites. The pilot study sites correspond with sites that will be used for the larger CAP LTER project that will sample 200 sites for many diverse variables. Data for each site has been collected for the years 1934, 1949, 1961, 1970, 1980, 1990, and 1995.

Poster A

Using a combination of aerial photographs and digital land use data, we have created time series for each of the 20 pilot sites in the CAP LTER study area. This poster shows the history of three of the pilot sites. These sites were chosen to show examples of the different urban forms within the CAP LTER study area.

Poster B

An analysis of land use change in the CAP LTER study area is expected to result in data that depict general trajectories for patterns of change. Transition sequences will be examined to see what patterns emerge in relation to a site's temporal and spatial orientation. This poster presents examples of different visualization techniques that could be used to describe these patterns.

Roach, W. J., A. Coppola, N. B. Grimm, D. Hope, G. D. Jenerette, M. Luck, and W. Zhu. ***Stream ecology in an urban environment: research opportunities in Indian Bend Wash, Scottsdale Arizona.*** Department of Biology, Arizona State University, PO Box 871501, Tempe, AZ 85287-1501.

Urban development dramatically affects fluvial systems at a variety of spatial and temporal scales. At large spatial scales, catchment land use, particularly the percentage of impervious surfaces, determines the proportion of rainfall that reaches stream channel as overland runoff versus subsurface flow. Land use also strongly affects water chemistry. At smaller spatial scales, anthropogenic changes in channel morphology constrain flow paths, limit interactions between surface and subsurface flows, and alter the relative proportion of runs, riffles, and pools along a stream. These changes may affect the cycling and retention of important nutrients like N and P as well as biotic variables. Urbanization may also affect the temporal dynamics of fluvial systems. For example, increased runoff from irrigation may change the proportion of time a channel is wetted, creation of ponds increases residence time in the system, and changes in physical characteristics of the stream may affect its recovery from disturbance.

We have begun to examine how urbanization has changed land use in the Indian Bend Wash watershed and how a flood control project in Scottsdale has altered physical structure and hydrology of lower portion of the wash. We outline questions about how urbanization affects the nutrient dynamics of fluvial systems in general and hypotheses for how these processes have affected Indian Bend Wash in particular.

Stabler, L. B., J. C. Blank, K. A. Peterson, and C. A. Martin. ***Spatial gradients of temperature and CO_2 concentration in metropolitan Phoenix.*** Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601.

Urban areas contribute to global warming through the urban heat island effect (UHI) and increased atmospheric CO_2 levels associated with combustion of fossil fuels. Urban vegetation can counter these effects through photosynthetic uptake of CO_2, shading, and evapotranspirative cooling. Our objective was to examine spatial patterns of early morning and afternoon temperatures and CO_2 concentrations along an urban to rural gradient. We measured temperature and CO_2 concentrations from a vehicle traveling at a constant speed along five transects over surface streets around the Phoenix metropolitan area during June 1999. Measurements were made around 0500 and 1500 hr for each transect on days when weather conditions were clear and calm. Temperatures were measured at approximately 175-m (0.1-mile) intervals with shielded copper constantan thermocouple wire mounted on the front of the vehicle at 0.5-m height. Atmospheric CO_2 was measured approximately every 350 m at a height of 2.5 m using an infrared gas analyzer in open system mode. All temperature data were normalized to data collected a Phoenix Sky Harbor Airport for the appropriate day and time. Data were then pooled and categorized based on distance from the Phoenix urban core, defined as the intersection of Central Avenue and Van Buren Street. Gradients of high to low temperature and CO_2 concentration existed from city center to the urban fringe. Greatest temperature differentials occurred during the morning, while CO_2 levels varied most during the afternoon. Mean temperature and CO_2 concentration in central Phoenix were 4°C and 12% higher, respectively, than at the urban fringe. These data suggest that under summer conditions, urban Phoenix has a distinct heat island and CO_2 dome effect.

Stabler, L. B., and C. A. Martin. ***Plant gas exchange in disparate land uses***.
Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601.

Maximum net gas exchange measurements were made monthly for one year on plants in single family residential, desert, and agricultural land use patches. Rainfall for the years was 207 mm and trees and shrubs in residential landscapes and agricultural (alfalfa) plants received supplemental water through irrigation. The time of day for maximum photosynthesis (P_{max}) was estimated based on preliminary seasonal diel measurements of gas exchange patterns in irrigated and non-irrigated landscapes. Gas exchange measurements were made with a portable infrared gas analyzer on recently physiologically mature tissue of plants within multiple site replicates of each patch type. In general, carbon assimilation (A), transpiration (E) fluxes, and stomatal conductance (gs), were lowest for plants in remnant desert sites and highest for alfalfa plants throughout the year. Seasonal patterns of plant gas exchange differed with land use. Highest A and E fluxes in the desert occurred during the late summer monsoon season. Conversely, highest A fluxes occurred in plants in residential and agricultural land uses in October and May, respectively, while E was highest for plants in both irrigated land use types in June. Seasonal diel gas exchange patterns differed in irrigated and non-irrigated plants in terms of magnitude and time of day for maximum fluxes. Fluxes of A and E were consistently higher for irrigated plants throughout the day during every season, and during the hottest seasons P_{max} occurred later in the day in irrigated plants. Patterns of summer and monsoon season A and E for both irrigated site types led to decreased instantaneous transpiration efficiency (ITE, A/E) as air temperature increased during the course of the day. Overall, ITE varied seasonally in all land uses and was negatively correlated with shoot temperature (r^2=-0.67). Based on these data, irrigation most affected plant gas exchange. Under well watered conditions, concomitant diel and seasonal changes in A, gs, shoot temperature, and ITE suggest that maximum landscape carbon assimilation was limited by shoot conductance during cooler seasons, but might have been limited by high temperature extremes during the hottest part of the year.

Stefanov, W. L., and P. R. Christensen. ***Comparative analysis of soil development on semiarid hillslopes using linear deconvolution of Thermal Infrared Multispectral Scanner (TIMS) data.*** Department of Geology, Arizona State University, PO Box 871404, Tempe, AZ 85287-1404.

Analyses of hillslope soil development, geomorphology, and sediment transport have traditionally been accomplished by detailed studies at small spatial scales. Examples of this scale of analysis are typified by the use of soil plots, topographic analysis and soil profiling of a specific catchment area, and more recently, erosion rate studies using cosmogenic nuclides. These research methods do not typically allow for extension of the results to larger geomorphic scales due to their site specificity. High spatial resolution (3-10 m/pixel) remotely sensed data collected in the thermal infrared (8-13 micrometers, or microns) can be used to expand the scope of investigation. The current work investigates changes in soil mineralogy using data collected by the NASA Thermal Infrared Multispectral Scanner (TIMS) to provide insight into soil development and sediment transport processes on the scale of an entire semiarid mountain range. Rock-forming (i.e., quartz, feldspar, pyroxene) and secondary minerals (i.e., calcite, clays, oxides) have characteristic features in the 8-13 micron range of the electromagnetic spectrum that determine a unique emissivity spectrum for each mineral. The energy emitted by each mineral present in the ground pixel combines to form a composite energy spectrum that is detected by the sensor. This mixed spectrum can be deconvolved into its component spectra using a linear least-squares fitting technique and a spectral library of endmember mineral or rock compositions. The ability to detect both primary and secondary minerals using thermal infrared data is advantageous as original parent material is frequently present in significant amounts in semiarid to arid hillslope soils.

Thermal infrared data was collected over the McDowell Mountains, Scottsdale, Arizona, at four meter/pixel ground resolution by the six-channel TIMS instrument in 1994. Six-point atmospherically corrected image spectra were extracted over three detailed study areas within the mountain range comprised of basaltic andesite, quartzite, and quartz monzonite (respectively). Undisturbed surficial soil samples were collected along four hillslope profile transects (oriented in the four cardinal directions) for each of the study areas. Emissivity spectra were acquired for the soil samples at the Thermal Emission Spectrometer Laboratory at Arizona State University (with subsequent optical determination of mineralogy) to validate the image spectral deconvolution results. The collected image spectra were used to create bedrock and soil unit maps for the three study areas. Relative depth of image spectral emission features was used as a proxy for dominant grain size within each pixel, and the ratio of parent to secondary minerals was used to assess degree of surficial soil development. Results of these analyses suggest that the degree of soil development across the three study areas is similar, with surficial hillslope material dominantly comprised of coarse (sand- to gravel-sized) particles. Localized regions of more highly developed soil material (detected using the proxies described above) may represent hillslope sediment storage reservoirs, and suggest that the study areas are transport-limited in the current climatic regime. Application of this technique to existing high resolution thermal infrared data from mountain ranges throughout the southwestern USA would allow for a regional assessment of the current sediment transport and soil development regime.

Stiles, A.[1], and S. Scheiner[2]. ***Plant community responses to habitat fragmentation within the Phoenix metropolitan area.*** [1]Department of Plant Biology, Arizona State University, PO Box 871601, Tempe, AZ 85287-1601; [2]Department of Life Sciences, Arizona State University West, 4701 W. Thunderbird Rd, PO Box 32352, Phoenix, AZ 85069-2352.

Habitat fragmentation is a ubiquitous process in the modern world. As the global population increases and new settlement expands into natural areas, formerly continuous ecosystems are often fragmented into landscape islands within the human dominated matrix. With the decrease in habitable area, effective population sizes of species are often reduced. Smaller populations occupying remnant patches may confront a greater extinction risk resulting from demographic, genetic, and environmental stochasticity. Additionally, exotic species invasions may promote competitive exclusion of native species.

This poster presents a progress report of an ongoing ecological investigation performed in order to assess the response of Sonoran Desert plant communities to fragmentation processes in the CAP LTER study site. As a result of urban development patterns, a number of undeveloped patches remain and are scattered throughout the Phoenix metropolitan area. Field data is collected by establishing transects through geomorphologically defined habitats (e.g., south-facing slopes, ephemeral washes) within each patch. These transects consist of 100 m^2 quadrats arrayed along a compass trajectory. Woody species are counted, and herbaceous species presence is recorded. In order to study the effect of grain size on the results, species presence within four 1 m^2 quadrats, nested within the larger plot, is recorded. Since last year's poster, the four original patches have been sampled more thoroughly, and data on four new patches have been added.

Analyses performed include generation of species-area curves from field data, fitting of model curves to empirical curves, ordination, indicator species analysis, and nestedness analysis. All empirical curves were generated using the EstimateS package. SYSTAT was used to fit the model curves to the empirical curves. Exponential and power curves provided the best fit to the field data; the logistic model provided adequate fit in a small minority of cases. The PCord package was used for ordination and indicator species operations. Indicator species were identified for six broadly defined habitat types. Degree of nestedness was assessed using the Nestedness Temperature Calculator. Woody species data sets for the patches were found to be significantly nested. Grain size, which refers to the scale of the sampling unit, was found to affect the results obtained.

Ward-Rainey, N., Y. Shi, and F. A. Rainey. ***Observing patterns of prokaryotic diversity along land use gradients of the CAP LTER.*** Department of Biological Sciences, Louisiana State University, Baton Rouge, LA.

This recently funded project involves a study of the patterns of prokaryotic diversity along land use gradients in the Central Arizona - Phoenix Long-Term Ecological Research (CAP LTER) site. The research site comprises the city of Phoenix and surrounding areas, including suburbs, agricultural regions, and undeveloped natural environments. We want to investigate the effect of urbanization on prokaryotic community composition and function. The project will address the following research objectives: (1) to discover new species of bacteria, (2) to determine patterns of cultured, non-cultured and metabolic prokaryotic diversity and their relationship to land use, (3) to determine if certain components of the prokaryotic community are ubiquitous irrespective of land use type, and (4) to add a prokaryotic component to an ongoing CAP LTER research project, to better understand the structure and function of urban ecosystems.

The methods used in the project, encompassing culturing and non-culturing approaches, have been chosen to allow detection of as much as possible of the prokaryotic diversity present in a given sample. Sampling will be performed according to a design which will include both intensive investigation of a small number of sites, and a broader study of a large number of sites. The project represents the first investigation of prokaryotic community composition within a relatively small geographic space containing various land use types. It will add a prokaryotic component to our understanding of the biodiversity of urban ecosystems and complement the current investigations at the CAP LTER site.

To date, we have investigated the culturable bacterial diversity within 20 samples, taken during a pilot study prior to the full sampling of 200 sites. The results show that the numbers and visible diversity of heterotrophic bacteria differ between sites. The numbers of culturable heterotrophs for the soil samples tested range from 8 x105 to 2 x107 cfu/g and 2.4 x106 to 6.9 x108 cfu/g when plated on Plate Count Agar and 1/10 strength Plate Count Agar, respectively. These data indicate that the culturing strategy we propose to employ in the full survey will enable us to investigate differences in culturable diversity between sites under different land use conditions. Information obtained using methodologies for determination of the uncultured and metabolic diversity will complement these data.

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Wu, J. ***Characterizing the spatial pattern of urban landscapes using a multiple scale approach: The effects of changing grain and extent.*** Department of Life Sciences, Arizona State University West, 4701 W. Thunderbird Rd, PO Box 32352, Phoenix, AZ 85069-2352.

To understand ecological consequences of urbanization, it is imperative to quantitatively characterize its spatial structure and to relate landscape pattern with ecological and socioeconomic processes. To achieve this goal requires a landscape ecological approach. A somewhat tricky problem is that spatial pattern often changes with the scale (grain and extent) of analysis. Instead of searching for the "correct" scale, which does not really exist, a multi-scale approach should always be used to capture the spatial characteristics of heterogeneously landscapes. This study demonstrates how such an approach can be used to reveal the spatial patterns of the Phoenix metropolitan landscape at different scales. We also compare landscapes with different degrees of human influences, addressing the question: How does human dominance affect landscape structure?