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

Seventh Annual Poster Symposium

January 19, 2005
Carson Ballroom, Old Main
Arizona State University

Sponsored by: International Institute for Sustainability, Arizona State University

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Agenda
January 19, 2005
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1:00-1:05	Opening - Nancy Grimm, PI and Co-Director, CAP LTER
1:05-1:10	Welcome from ASU President Michael Crow
1:10-1:15	Introduction of William Schlesinger - Grimm
1:15-2:15	Keynote Address – **William H. Schlesinger, James B. Duke Professor of Biogeochemistry and Dean of the Nicholas School, Duke University** ***Global Carbon Cycle and the Duke Forest Free-Air CO_2 Enrichment (FACE) Project***
2:15	Instructions to presenters
2:15-3:15	Poster Session #1
3:15-3:30	Social with refreshments
3:30-4:30	Poster Session #2

William H. Schlesinger

William H. Schlesinger is James B. Duke Professor of Biogeochemistry, and, Dean of the Nicholas School of the Environment and Earth Sciences at Duke University.

Completing his A.B. at Dartmouth (1972), and Ph.D. at Cornell (1976), he joined the faculty at Duke in 1980. He is the author or coauthor of over 160 scientific papers and the widely-adopted textbook *Biogeochemistry: An analysis of global change* (Academic Press, 2nd ed. 1997). He was elected a member of the American Academy of Arts and Sciences in 1995 and The National Academy of Sciences in 2003. He was President of the Ecological Society of America for 2003-2004.

Currently, Schlesinger focuses his research on global change ecology. He is the co-principal investigator for the Free Air Carbon Dioxide Enrichment (FACE) Experiment in the Duke Forest–a project that aims to understand how an entire forest ecosystem (vegetation and soils) will respond to growth in elevated CO_2. He has also worked extensively in desert ecosystems and their response to global change-often leading to the degradation of soils and regional desertification. From 1991 to 2000, he served as Principal Investigator for the NSF-sponsored program of Long Term Ecological Research (LTER) at the Jornada Basin in southern New Mexico. His past work has taken him to diverse habitats, ranging from Okefenokee Swamp in southern Georgia to the Mojave Desert of California. His research has been featured on NOVA, CNN, NPR, and on the pages of *Discover, National Geographic, The New York Times*, and *Scientific American*.

Schlesinger has testified before U.S. House and Senate Committees on a variety of environmental issues, including preservation of desert habitats and global climate change.

Dr. Schlesinger's visit is being co-sponsored by CAP LTER, International Institute for Sustainability, and the School of Life Sciences.

2005 CAP LTER Symposium

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Susanne Grossman-Clarke, Joseph A. Zehnder, U. Liu, and J. D. Fast. ***Testing a planetary boundary layer schema in MMS for the Phoenix metropolitan region.***

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Elizabeth Farley Metzger, S. Yabuki, Patricia Gober, David Casagrande, Charles Redman, Nancy Grimm, and Sharon Harlan. ***Initial findings of the North Desert Village Landscaping Experiment: The green, green grass of home.***

Bill Edwards, Nancy S. Jones, Patricia Gober, and Charles L. Redman. ***Investigating human decision making under climatic uncertainty.***

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Natalie Case, Milton Sommerfeld, and Qiang Hu. ***Utilizing microalgae to remediate nitrate-contaminated groundwater.***

Nancy B. Grimm, Jason P. Kaye, Sharon J. Hall, Jonathon O. Allen, and David B. Lewis. ***A distinct urban biogeochemistry?***

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Laura Becht. ***Landscape-level influences of urbanization on reptile communities in the Phoenix metropolitan area.***

Robert J. Bills and Jean C. Stutz. ***Arbuscular mycorrhizal fungal species richness is lower in the Phoenix metropolitan area in comparison to the surrounding desert.***

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Stanley H. Faeth, Paige S. Warren, Eyal Shochat, and Wendy A. Marussich. ***Trophic dynamics in urban communities.***

Kris Gade and Ann P. Kinzig. ***The role of nitrogen in plant migration along freeway corridors in Phoenix, Arizona.***

Matthew Harwood. ***Does phosphorus limit growth in insects?***

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Hoski Schaafsma and John Briggs. ***Legacies of farming in central Sweden: An archaeological perspective on modern plant communities.***

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Jean C. Stutz, Robert J. Bills, Jamaica R. Cousins, Linda B. Stabler, Sean Whitcomb, and Chris A. Martin. ***Arbuscular mycorrhizal fungi in the Phoenix metropolitan area: Diversity and functioning.***

Jason S. Walker. ***Birds of a feather: A story of urban and exurban avian population biology.***

Paige Warren and Erin Adley. ***Effects of predators and landscaping type on avian ground-foraging behavior in Phoenix parks.***

Jacqueline White and Juliet Stromberg. ***Effects of river modification on the riparian soil seed back of the Salt River, Arizona: A case study of an arid region river.***

EDUCATION AND OUTREACH

Monica Elser and Charlene Saltz. ***Graduate students and* Ecology Explorers: *Challenges and benefits.***

John Jung. ***Concept maps: A multipurpose tool for environmental education.***

Kathryn Kyle. ***Open-ended inquiry in the schoolyard.***

Shea Lemar, Charlene Saltz, and Monica Elser. ***Middle school students performing university level environmental work.***

Charlene Saltz, Nancy Crocker, Danielle Taddy, Debra Banks, and Monica Elser. ***Service at Salado, an urban environmental service-learning project.***

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Corinna Gries, Nancy B. Grimm, Charles L. Redman, Ravi Peri, and Peter McCartney. ***The new intranet and data management for CAP2***.

Nancy Grimm and Charles L. Redman. ***Reorganizing research teams into Integrated Project Areas (IPA) for CAP2.***

ABSTRACTS

All abstracts are listed alphabetically by first author.

Becht, L. C. School of Life Sciences Graduate Programs, Arizona State University, PO Box 874601, Tempe, AZ 85287-4601. ***Landscape-level influences of urbanization on reptile communities in the Phoenix metropolitan area.***

This proposed research focuses on the effects of landscape fragmentation of habitat and increased patch isolation on populations of lizards in Phoenix and the surrounding urban area. The goal is to produce a spatially realistic GIS model that investigates the influences of the structure and composition of the surrounding landscape on lizard populations within patches of desert remnant habitat. This landscape level analysis will provide information on the relationships between abiotic and biotic variables and the distribution and abundance of five lizards occurring in the Phoenix metropolitan area of the Sonoran Desert. Remote-sensing data, GIS, ecological modeling, and field surveys will be combined to model habitat degradation and species abundance for five lizard species utilizing habitat along the urban gradient. Model development will include a model-building phase followed by field testing of predictions of species distribution. Initially, a habitat model will be developed for each species based on known habitat preferences. Remote-sensing imagery will be used in association with GIS coverages of land cover to identify patches of potential habitat. Information on species home range and dispersal patterns will then be incorporated into the model and used to identify potential habitat patches. A sample of the potential patches will then be visited to determine presence/absence and species abundance. The model will then be analyzed for relationships between the structure of the landscape, attributes of the habitat patches, and species abundance.

Bellefeuille, M., M. Sommerfeld, and Q. Hu. School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501. ***Use of the green microalga* Scenedesmus obliquus *for bioremediation of nitrate-contaminated agricultural runoff in an outdoor photobioreactor.***

Nonpoint sources of nitrate-polluted water from agricultural runoff can contaminate large aquifers over time. Collecting and treating agricultural runoff to remove nitrate before it percolates into the ground can protect aquifers from contamination in the future. We have explored the feasibility of using the green alga, *Scenedesmus obliquus*, for nitrate remediation of high-nutrient water sources. Under laboratory conditions, we studied the effects of temperatures from 20 to 40˚C and light intensity from 15 to 350 umol m^{-2} s^{-1} on algal growth and nitrate removal. Successful indoor experiments for nitrate bioremediation under these varying light and temperature experiments were encouraging and led us to extend the research to a field pilot-scale (400 L) photobioreactor. Mass culture in the outdoor bioreactor

during peak Arizona summer temperatures and solar radiation demonstrated the feasibility for nitrate reduction under natural conditions encountered outdoors by our system. Water from local surface runoff containing nitrate levels of 30 mg/L was reduced to nearly zero in the photobioreactor within two days. We are currently assessing the operational feasibility under winter temperatures and plan to develop a demonstration-scale photobioreactor for on-site remediation of agricultural runoff at a nearby farm site.

Bills, R. J.[1], and J. C. Stutz[2]. [1]School of Life Sciences Graduate Programs, PO Box 874601, Arizona State University, Tempe, AZ 85287-4601: and [2]Department of Applied Biological Sciences, Arizona State University East, 7001 E. Williams Field Rd, Mesa, AZ 85212. ***Arbuscular mycorrhizal fungal species richness is lower in the Phoenix metropolitan area in comparison to the surrounding desert.***

Little is known about the impact of urbanization on arbuscular mycorrhizal (AM) fungal community structure. This investigation compares AM fungi from urban and desert sites that were part of the CAP LTER Survey 200 Project. Soil was collected from nonindigenous landscape plants and indigenous plants at urban sites and from indigenous plants at desert sites and used to start pot cultures in the greenhouse to obtain AM fungal spores for identification. We detected differences in AM fungal community structure between urban and desert areas. The total number of AMF species detected was greater in the desert than urban areas. One-third of the AMF species found in the desert were not found in the urban area, with seven AMF species found only in the desert sites and one species found only in urban sites. The mean number of AMF species/plant and the mean number of species/site was greater at the desert sites in comparison to the urban sites. Despite these differences there was a significant overlap in the species composition between the desert and urban sites. The most frequently detected species were similar. *Glomus intraradices, G. microaggregatum, G. mosseae, G. eburneum* and *G. spurcum* were detected in over 50% of the desert and urban sites. Comparisons were also made between the AM fungal communities associated with two indigenous plants, *Larrea tridentata* and *Parkinsonia* spp., found to be growing in the desert and in the urban sites. The total number of AMF species associated with both plants was greater at desert sites in comparison to urban sites. There was a greater mean number of AMF species/plant detected in the desert versus the urban area for *Parkinsonia* spp., but there were no differences in the mean number of AMF species/plant between plants growing in the desert versus urban areas for *L. tridentata*.

Block, J., Department of Geological Sciences, Arizona State University, PO Box 871404, Tempe, AZ 85287-1404. ***Channel morphology and instability along the urban fringe: Flood frequency, and flood hazards in the Hassayampa River region and its relationship to the greater Phoenix area***.

In order to understand the effects of human modifications to watersheds and main stem channel systems in desert environments, it is necessary to characterize the unmodified system before human activities change it. With progressive urbanization in greater Phoenix, development is expanding beyond the valley onto the piedmonts and the uplands. With this growth comes exposure to channel instability, as well as feedbacks to the channel system by urbanization-driven surface changes. Some of these changes include surficial material changes that change rainfall-runoff relationships, channel engineering, damming, and construction of gravel pits in the channel bed. The bulk of the Hassayampa River region, west of Phoenix, has not yet been affected by human modification, but there are several plans for development along the river channel over the next 20 years. In this project, I have investigated how the Hassayampa River's channel morphology has changed over time in order to compare it to other channel systems in greater Phoenix that have already been urbanized, and consider how it may change as it urbanizes in the near future.

I used aerial photography, flood frequency analyses, public agency reports, and historical documentation including private and newspaper accounts to document lateral changes in channel position caused by lateral erosion and overbank flooding along the Hassayampa River over time in order to understand flooding frequency, magnitude, and the tendency of these channels to change during varying magnitudes of precipitation events.

The results show that in desert environments, any storm of significance will create changes to the fluvial system, but magnitude and frequency of the events are important factors to quantifying hazard. I also discovered that because most of the Hassayampa River is not yet urbanized, not much historical documentation exists regarding the channel, thus limiting long-term projections of flood frequencies.

Buyantuyev, A., and J. Wu. School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501. ***Accuracy assessment of vegetation cover estimated with remote-sensing data.***

The focus of this presentation is on the problems of accuracy assessment of land cover classification and vegetation estimation based on remote-sensing data, including the nature and magnitude of errors involved. We conducted error analysis on the statistical relationships between projected foliage cover, obtained from the 200-point survey and Landsat-derived linearly unmixed vegetation (urban and desert sites), and vegetation indices (agricultural sites). Several bivariate linear regressions (standard OLS, the inverse OLS (X|Y), $OLS_{bisector}$, and Reduced Major Axis) were developed. We used cross-validation and bootstrapping methods to test

these statistical models. Although these models showed similar ability to explain variation in data, they had noticeably different slopes, reflecting the differences in the fundamental assumptions of these models. The models were compared in terms of overall bias, root mean square errors (RMSE) and variance ratios. $OLS_{bisector}$ regression provided a better fit for desert sites (less error), but standard OLS was superior for urban plots. However, the use of traditional OLS, which assumes no measurement errors in predictor variables, is considered flawed in principle.

In addition, we used RMSE and standard error (SE) to assess the accuracy of the map of vegetation abundance. We randomly placed additional 90×90 meter validation plots (9 Landsat pixels) stratified by major land uses. Fifty plots were allocated to urban land uses, 50 to agricultural land use, and 100 plots were forced to the surrounding desert. Each plot was segmented into homogenous patches using high-resolution, color aerial photography. Easily identifiable vegetation patches were semi-manually digitized to compute the total area. Percent vegetation cover was then compared with cover estimated by $OLS_{bisector}$ regression models and averaged for nine Landsat pixels. The results suggest acceptable overall accuracy.

Case, N., M. Sommerfeld, and Q. Hu. School of Life Sciences, Arizona State University PO Box 874501, Tempe, AZ 85287-4501. ***Utilizing microalgae to remediate nitrate-contaminated groundwater.***

Nutrient contamination of local groundwater sources is often a problem in areas with concentrated agricultural and animal production. Due to its high permeability, nitrate from runoff can be found in groundwater at concentrations exceeding EPA limits. As a result, the amount of useable drinking water is reduced. Currently, there are no cost-efficient methods employed by water companies to remove nitrate contamination on a large scale. We have examined the cultivation of microalgae in contaminated groundwater as a sustainable, cost-efficient approach to remove nitrates. Microalgae grow very rapidly, requiring only light, carbon dioxide, and nutrients. Several strains of algae have been isolated and tested in order to select for the highest rate of growth and nitrate removal in groundwater. Currently, field experiments are being conducted in a 400-L capacity bioreactor using one of these strains, and preliminary results look promising. It should be feasible to construct a bioreactor at a well to process contaminated groundwater. To offset costs of running the bioreactor, algal biomass may be harvested and sold for animal feed supplements, health foods, and other valuable products.

Collins, T. Department of Geography, Arizona State University, PO Box 870104, Tempe, AZ 85287-0104. ***People, forests, and fire hazard vulnerability in Arizona's White Mountains.***

Large fires have occurred with increasing frequency in forests of the American West. Many locales at risk to fire have grown rapidly in recent decades. These trends have amplified fire hazards in the wildland-urban interface (WUI), the zone where features of human development intermingle with wildland vegetation. The 2002 Rodeo-Chediski Fire burned nearly 200,000 ha and destroyed over 465 homes in ponderosa pine forests of Arizona's White Mountains. Accounting for both Rodeo-Chediski and a severe bark beetle epidemic, over one-third of regional ponderosa pine forests have been qualitatively changed.

Few socially attuned studies of sources, consequences and responses to WUI forest problems exist. This paper addresses one research question: Are certain social groups, due to their marginal positions, more vulnerable than others to the effects of forest change? In order to address this question I conducted inquiry in three diverse case-study communities for 14 months.

In answering the research question I drew from residents the constraints faced every day in protecting their lives, livelihoods, property and community forests from fires. The analysis has one focus: a comparison of fire-hazard vulnerability between amenity migrants (i.e., part-time residents) and permanent residents based on household survey data collected door-to-door and follow-up interviews. These data are supplemented by interviews with key informants to better understand sources of fire-hazard vulnerability. This research informs theoretical discussions of hazard vulnerability social-ecological resilience. In practical terms, findings are being circulated in the policy arena to better match management efforts with residents' needs.

Cook, W. M. International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. ***Long-term bird community patterns at Phoenix's Desert Botanical Garden.***

There are many examples of landscape transformations in urban areas that are detrimental to wildlife, but human activities can sometimes provide new and beneficial habitats for wild species. In this poster I document the changes in bird species diversity and frequency of observation over the period 1987-2004 at the Desert Botanical Garden (DBG), located in a desert park between the cities of Phoenix, Tempe, and Scottsdale, Arizona, and associate these patterns with the history of human development at DBG. Despite its focus on desert vegetation, the DBG has gradually become a lush urban oasis because of irrigation and management of its plant collections. During the study period several major habitat exhibits have been added to the Garden, including a pond and cottonwood grove and a large wildflower garden, plus numerous small water features. Weekly bird walks were

conducted throughout the 1987-2004 interval, with species presence or absence recorded. Over time the number of species per observation period increased significantly, from roughly 20 to over 30. Moreover, several occasional visitors to the DBG became permanent or breeding residents of the Garden, including cardinal, brown-crested flycatcher, and lesser goldfinch. Other species increased their season period of residence, including white-winged dove and ruby-crowned kinglet. The largest increases in observed species richness, in the late 1980s and early 2000s, corresponded roughly with the construction of new habitats and increases in availability of water in the landscape. This study suggests that increased human management of a desert habitat can provide increased opportunities for wildlife, particularly if supplemental water is available, and that under certain circumstances human efforts to create habitats in areas where they might not normally exist can be beneficial to wildlife.

Edwards, B., N. S. Jones, P. Gober, and C. L. Redman. Decision Center for A Desert City, International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. ***Investigating human decision making under climatic uncertainty.***

A new NSF funded ASU center brings science to policy issues of water resources and urban growth. The current six-year drought, the specter of increasing temperatures and greater rainfall variability resulting from global climate change, and the intensifying and expanding urban heat island has led to growing concern about the region's water future and has motivated water managers to collaborate with ASU scientists and policy analysts to enhance the region's adaptive capacity to deal with climate uncertainties in the future. The Decision Center for a Desert City (DCDC) will utilize the expertise of ASU researchers to help cities face critical decisions on growth and water usage. In addition, DCDC seeks to build a new model of science and policy engagement that allows decision makers and scientists to collaborate on important research questions and experiment with new methods. DCDC will be closely aligned with ASU's Decision Theater, a 3-D immersive space for outreach to the community.

Elser, M., and C. Saltz. International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. ***Graduate students and Ecology Explorers: Challenges and benefits.***

K-12 education outreach programs are one way that universities share their ongoing research projects with the community. As active participants in research, graduate students can contribute positively to these outreach programs. They can also gain experience in sharing their research with the general public. We have

integrated graduate students into the *Ecology Explorers* program, the K-12 outreach program of the Central Arizona–Phoenix Long-Term Ecological Research project, since its inception. The role played by these graduates students range from short-term contact with teachers and students to year-long placement in class-rooms via Arizona State University's GK-12 program. This poster will focus on some of the challenges and benefits associated with incorporating graduate students into the *Ecology Explorers* program.

Faeth, S. H.[1], P. S. Warren[2], E. Shochat[3], and W. A. Marussich[4]. [1]School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501; [2]Department of Natural Resources Conservation, Holdsworth Natural Resources Center, University of Massachusetts, Amherst, MA 01003; [3]University of Oklahoma, Sutton Avian Research Center, PO Box 2007, Bartlesville, OK 74005; and [4]Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ 85721. ***Trophic dynamics in urban communities.***

Human activities dramatically change abundances, diversity, and composition of species. However, little is known about how the most intense human activity, urbanization, alters food webs and trophic structure in biological communities. Our observational and experimental studies of control of food webs in the CAP LTER, situated amid the Sonoran Desert, reveal some surprising alterations in control of trophic dynamics. Species composition is radically altered and resource subsidies increase and stabilize productivity. Changes in productivity dampen seasonal and yearly fluctuations in species diversity, elevate abundances, and alter feeding behaviors of some key urban species. In contrast to outlying deserts where limiting resources dominate, predation by birds becomes the dominant force controlling arthropods on urban plants. Reduced predation risk on elevates abundances and alters foraging behavior of birds such that urban birds exert increased top-down effects on arthropods. Shifts in control of food web dynamics are likely common in urban ecosystems, and are influenced by complex human social processes and feedbacks.

Farley Metzger, E.[1], S. Yabiku[2], P. Gober[3], D. Casagrande[4], C. Redman[1], N. Grimm[5], and S. Harlan[2]. [1]Department of Anthropology, Arizona State University, PO Box 872402, Tempe, AZ 85287-2402; [2]Department of Sociology, Arizona State University, PO Box 872101, Tempe, AZ 85287-2101; [3]Department of Geography, Arizona State University, PO Box 870104, Tempe, AZ 85287-0104; [4]International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; and [5]School of Life Sciences, Arizona State University, PO Box 874601, Tempe, AZ 85287-4601. ***Initial findings of the North Desert Village Landscaping Experiment: The green, green grass of home.***

Droughts and water shortages, combined with explosive growth of urban and suburban areas, have created a situation that is being viewed with increasing concern across the western United States. Efforts by officials to entice water consumers to switch to low water use residential landscapes have met with limited success, due in part to a lack of understanding of the key factors that influence residential landscaping decisions. This study, which includes both quantitative and qualitative data on landscaping preference and environmental values, will help inform public policy. The study is based on interviews with residents of a single-family housing development in metropolitan Phoenix, Arizona. In a structured survey, residents viewed and rated computer-generated landscaping scenarios and were asked to choose their preferred landscape. They also rated their concern about a variety of environmental issues, including water shortages. Qualitative analysis was done on open-ended questions about landscape preference and water issues. Respondents in our study overwhelmingly preferred the water-intensive landscape. Results indicated no correlation between residents' concern about environmental issues and their choice of landscape. In analyzing the discourses from the open-ended questions and other comments made by residents, it was determined that cultural constructions of 'home' and 'family' are major factors influencing landscaping preference. There is a strong perceived connection between green landscaping and idyllic families. We also hypothesize there is a historico-religious legacy involved in landscaping preference. One third of the study population are members of the Church of Jesus Christ of Latter-Day Saints (LDS). We believe that 'family' is an especially strong identity component for LDS members and this may be having a relatively greater impact on landscape preference. Also, 'making the desert bloom' is a significant part of the narrative of the LDS Church. This is likely to have an impact on Church members' attitudes toward water conservation.

Gade. K. J., and A. P. Kinzig. School of Life Sciences Graduate Programs, Arizona State University, PO Box 874601, Tempe, AZ 85287-4601. ***The role of nitrogen in plant migration along freeways corridors in Phoenix, Arizona.***

As part of a larger study of the role of freeway corridors in plant migration, plant-available nitrate levels were measured in soils at 20 sites along freeway verges across the Phoenix metropolitan area. At each site, samples were collected along transects within the freeway right-of-way at three distances from the sealed portion of the freeway. Plant-available nitrate was elevated in most verge soils, particularly in the 10 meters closest to the sealed portion of the freeway. Land use in the square mile adjacent to the freeway verge is significantly related to plant-available nitrate found in the soil samples, with urban landscaped land cover having the highest nitrate levels, followed by croplands, then low-density (fringe) landscaped land cover, and the lowest levels in verges adjacent to desert. These results support other studies' findings that traffic-derived pollutants (both gases and particulates) contribute to nitrogen concentrations in roadside soils, particularly in the areas

immediately adjacent to the road surface. Traffic-related forms of nitrogen appear to have a greater contribution to roadside plant-available nitrate concentrations than adjacent land cover. The results illustrate the ties between traffic management, roadside maintenance and landscaping, urban land use, and the ecology of roadside plant communities.

Gries, C., N. B. Grimm, C.L. Redman, R. Peri, and P. McCartney. International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. ***The new intranet and data management for CAP2***.

Capturing information about our research activities as they happen is vital to our ability to document and report our data and findings to the community and NSF. A web site (intranet) has been developed where every CAP LTER researcher can log in to submit, review and edit his/her personal information, publications, active projects, descriptions of datasets he/she is developing or has published, and annual reports. It will play a central role in project, publication and data tracking in CAP2 as it gives the researcher direct input to what is published in the annual reports and on the CAP website. The poster describes features of the intranet and planned training activities for introducing the intranet into the CAP routine.

Grimm, N. B.[1], J. P. Kaye[1], S. J. Hall[2], J. O. Allen[3], and D. B. Lewis[1]. [1]School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501; [2]The Colorado College, 14 E. Cache La Poudre St., Colorado Springs, CO 80903; and [3]Department of Civil and Environmental Engineering, Arizona State University, PO Box 875306, Tempe, AZ 85287-5306 and Department of Chemical and Materials Engineering, Arizona State University, PO Box 876006, Tempe, AZ 85287-6006. ***A distinct urban biogeochemistry?***

Urban ecosystems present challenges to biogeochemical theory. Do patterns and processes of urban biogeochemistry differ fundamentally from those of non-urban ecosystems? Ecosystem theory holds that, on annual time scales in terrestrial ecosystems, the importance of internal N recycling far outweighs external inputs. Theory also holds that C cycles are relatively open, and C fixation by plants fuels most heterotrophic microbial growth. Little is known about ecosystem effects of vastly increased rates of N deposition from urban atmospheres (up to 30 kg ha^{-1} y^{-1} downwind of Phoenix). Moreover, atmospheric organic C particles from cooking and combustion may be a significant flux into urban ecosystems, and may be accessible to heterotrophic microorganisms in soil. Intensive, localized management also contributes enhanced nutrient inputs. We hypothesize that these and other patterns produce nutrient cycles in urban ecosystems that differ from those of non-urban ecosystems, and we will test this hypothesis in a new project that focuses on the

impact and fate of deposition of atmospheric inorganic N and organic C in desert and desert-remnant patches. Two subsidiary hypotheses are that soil microbes are decoupled from plants owing to high deposition to soils, and that N supply may increase to the point that P limits plant growth. In preliminary investigations, we used published atmospheric modeling results to predict desert locations of low and high deposition within and outside the CAP study area, and measured short-term dry deposition, soil pools and processes, and plant chemistry. Plant stoichiometry and soil processes differed among sites with different atmospheric N deposition rates. We maintain that whether cities exhibit a distinct urban biogeochemistry depends upon the extent to which high or unique material inputs alter interactions among element cycles.

Grimm, N.B., and C.L. Redman. International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. ***Reorganizing research teams into Integrated Project Areas (IPA) for CAP2.***

An innovative new approach to organizing research has been proposed for CAP2. Our experience in CAP1 taught us that for investigating the urban or "designer" ecosystem, old categories must be integrated in new ways to facilitate interdisciplinary research. Therefore, the new CAP2 organization features groupings of researchers called "Integrative Project Areas (IPA)"; defined by the subject matter of our investigations, and "Working Groups," defined by the tools and approaches to the science. Each IPA intersects with one or more LTER core areas, but the new research organization aids in explicit inclusion of socioeconomic drivers and feedbacks. The five IPAs are: Land-Use and Land-Cover Change, Climate-Ecosystem Interactions, Water Policy, Use, and Supply, Fluxes of Materials and Socio-Ecosystem Response, Human Control of Biodiversity. Research teams and ongoing research projects are displayed for each Integrated Project Area and may also be reviewed at the CAP LTER website (http://caplter.asu.edu).

Grineski, S. Department of Sociology, Arizona State University, PO Box 874802, Tempe, AZ 85287-4802. ***Children's vulnerability to unmanaged asthma in the Phoenix metropolitan area.***

The research identifies areas and groups that were most vulnerable to excess hospitalizations due to asthma in 2003 among children under 15 using Geographic Information Systems (GIS). Hospitalization data can be used to indicate unmanaged asthma, but not asthma prevalence or emergency room visits due to asthma. Preliminary findings indicate that Black and Hispanic-White children are hospitalized at significantly higher rates than their proportion of the population suggests, whereas this is not the case for Non-Hispanic White children. Regression analysis was

then used to predict hospitalizations for Non-Hispanic White, Black, and Hispanic-White children using census variables at the postal code level. Median income and percentage of households with vehicle available were significant predictors of asthma hospitalizations at the postal code level for Hispanic-White and Non-Hispanic White children. Median year home structure was built and percentages of households with vehicle available were significant predictors of asthma hospitalizations at the postal code level for Black children.

Grossman-Clarke S.[1], J. A. Zehnder[2,3], Y. Liu[4], and J. D. Fast[5]. [1]International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; [2]Department of Geography, Arizona State University, PO Box 870104, Tempe, AZ 85287-0104; [3]Department of Mathematics, Arizona State University, PO Box 871804, Tempe, AZ 85287-1804; [4]National Center for Atmospheric Research/RAP, PO Box 3000, Boulder, CO 80301; and [5]Pacific Northwest National Laboratory, PO Box 999, Richland, WA 99352. ***Testing a planetary boundary layer scheme in MM5 for the Phoenix metropolitan region.***

The physical representation of planetary boundary layer processes is important for applying mesoscale meteorological models to study the influence of urban areas on thunderstorm propagation; interactions of the urban with the rural thermal environment through mesoscale circulations; and the influence of land use/cover changes on air quality and near-surface meteorological variables.

A new version of the Medium Range Forecast (MRF) planetary boundary layer scheme is available from the National Center of Atmospheric Research (NCAR) for use in the fifth-generation PSU/NCAR Mesoscale Meteorological Model MM5. The modified MRF scheme was enhanced by new surface flux and non-local mixing approaches and therefore enables a better representation of boundary layer height and surface wind speed. Furthermore updated land use/cover data and bulk approaches for characteristics of the urban surface energy budget such as heat storage, the production of anthropogenic heat and radiation trapping were introduced in MM5's MRF scheme.

The modified MRF scheme was tested against experimental data from two field campaigns in May/June 1998 and June/July 2001 conducted in the Phoenix (Arizona, USA) metropolitan area. The simulated vertical temperature and wind profiles were compared with radar wind profiler, radiosonde and sodar data. Significantly improved simulation results for wind speeds and temperatures as well as the evolution of the height of the planetary boundary layer were obtained with the modified MM5.

Harwood, M. Chandler High School, 350 N. Arizona Ave, Chandler, AZ 85225. ***Does phosphorus limit growth in insects?***

Phosphorus has a role in many important biological structures—RNA a most notable one, and though not yet totally verified, phosphorus may be critical in limiting growth of insects. Therefore, faster-growing insects have more phosphorus than slower-growing ones. Thus, the African honeybee (*Apis mellifera scutaletta*) will have higher level of phosphorus in its body than the European honeybee (*Apis mellifera linguistica*), because the African honeybee develops faster than the European honeybee. The amount of phosphorus in an organism can be found using a phosphorus assay, which digests the organism with persulfate and colors it with a phosphorus reagent. The colored samples are run through a spectrophotometer along with stock phosphorus solution that underwent the assay—used to produce a standard curve. After 20 trials of 10 African and 10 European honeybees to determine the amount of phosphorus in the bees in their larval stage (age matched within two days), a statistically meaningful difference occurred in the phosphorus levels between the two species, a difference of about .075 mean percent phosphorus with the African honeybee having more phosphorus a per unit of body weight than the European honeybee. These results are preliminary, because so few sample were run. In the next few months, running African and European honeybees of the same age (5th instar preferably) will expectedly strengthen the hypothesis that African honeybee has more phosphorus than European honeybees, and overall, that phosphorus limits insect growth.

Ingram, S. E. Department of Anthropology, Arizona State University, PO Box 872402, Tempe, AZ 85287-2402. ***Streamflow and demography in the lower Salt River basin of central Arizona, ca. A.D. 775 to 1450.***

Floods and droughts and their effects on Hohokam irrigation agriculture play a prominent role in many cultural-historical interpretations of the Hohokam trajectory in the Salt River basin of central Arizona. Catastrophic floods and associated geomorphic stream channel changes (inferred from tree-ring records) may have contributed to settlement and population changes and the substantial depopulation of the lower Salt River basin ca. A.D. 1450 or later. An examination of population growth and decline (inferred from domestic architecture in a well-documented canal system) indicates that population levels generally increased as the variability and frequency of inferred floods and droughts increased. The results of this analysis contradict commonly held assumptions regarding the negative effects of floods, droughts, and high variability on prehistoric irrigation agriculture in the lower Salt River basin. The broader impacts to society of this research include enhanced understanding of the conditions that promoted stability, transformation, and sustainability in coupled social and ecological systems in the past.

Judkins, G., and E. Keys. Department of Geography, Arizona State University, PO Box 870104, Tempe, AZ 85282-0104. ***Patterns of NAFTA-induced land-use change in Mexican agriculture.***

This research refines the understanding of how liberalized economic relations influence agricultural land-use by identifying and distinguishing between the proximate and distal causes of such change. Patterns of Mexican land-use in produce cultivation are studied within the context of the North American Free Trade Agreement (NAFTA). A hybridized cultural and political ecology approach is employed, allowing localized field research to be "scaled-up" to the broader economic and social context of the global environmental change literature while avoiding a priori explanations for land-use change. This study focuses on produce cultivation due to its strong association with NAFTA as a form of export-oriented agriculture. The municipality of Mexicali, Mexico, was chosen as the research area, based on its identification within the literature as a site experiencing a shift away from the more traditional field crops toward export-driven produce cultivation. Such change is identified through remote-sensing techniques, geographic information systems and agricultural statistics, and explained in field research based on directed interviews with experts, local land-users and an assessment of pertinent background literature. This research offers a practical assessment of patterns of land-use change occurring within Mexican commodity agriculture, and has theoretical significance to the debate surrounding the land-use impacts of globalization. The liberalized economic relations of NAFTA are seen as the formalization of economic trends already in existence and therefore not the initial, primary driving forces behind land-use change in Mexican produce cultivation.

Jung, J. School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501 and Mesa High School, 1630 E. Southern Ave, Mesa, AZ 85204. ***Concept maps: A multipurpose tool for environmental education.***

Concept mapping is a versatile tool for education and research, especially in the environmental sciences. In the 1970's, Joseph Novak and his team of researchers at Cornell University developed this graphic organizer based upon the learning theories of David Ausubel. According to Ausubel, meaningful learning occurs when new knowledge is consciously and purposefully linked to an existing framework of prior knowledge in a nonarbitrary, substantive fashion. He theorized that cognitive structure is hierarchically organized in large, interconnected arrays, where pieces of knowledge are conceptually linked to other pieces. Concept maps will manifest the learner's knowledge structure of many content areas and can be applied to numerous learning objectives, but are particularly useful when teaching and assessing interrelationships. The National Science Education Standards stresses the

need for all K-12 students to develop understanding and abilities aligned with systems, order, and organization. The North American Association for Environmental Education lists among its core of key principles systems, interdependence, integration, and infusion. The purpose of this project was to use concept maps in designing the curriculum of a high school environmental science course, in teaching environmental topics, and in assessing student synthesis of interrelationships. The student-centered curriculum design utilizes macro- and micro- maps (or hyperlinks) to align classroom activities and state standards with a given unit's key concepts. Students construct by the year's end a very large and comprehensive concept map that begins with an inventory of each student's personal resource consumption and waste production, branches into micro-maps of energy, water, and forest concepts, and concludes with links to the superordinate concepts of population and ecosystems. The inexperienced concept map reader is typically awed by the size and complexity of these "Ecosystem" maps. But the educational reward – synthesis of environmental interrelationships – accrues primarily to the mapper, not to the reader.

Kyle, K. International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. ***Open-ended inquiry in the schoolyard.***

We hypothesized that early elementary-aged children are capable of successfully engaging in open-ended science inquiry, and found that to be true of first-grade students at a private school in Phoenix, Arizona. Sixteen students conducted open-ended inquiry on their school grounds for a full academic year. They were able to pose and answer their own questions about the ecology of their schoolyard, and developed process skills at the third-grade level as stated in the Arizona State Science Standards. This work indicates that very young students can master significant science process skills when allowed to conduct genuine, open-ended inquiry into their own questions related to phenomena with which they have had experience–in this case, those occurring outdoors on their school grounds.

Larson, E. K., and N. B. Grimm. School of Life Sciences, Arizona State University, PO Box 874601, Tempe, AZ 85287-4601. ***Nitrogen dynamics in urban man-made lakes: Denitrification potential of sediments.***

Terrestrial and aquatic components of urban landscapes experience substantial nitrogen (N) loading via application of fertilizer, fossil fuel combustion with associated N oxide production and deposition, and introduction of N-fixing legumes. Heavy N loading can result in loss of biodiversity, changes in nutrient limitation status for vegetation, eutrophication of receiving waters, and, if present in high quantities in drinking water, a public health threat. Denitrification is a microbial process that converts nitrate (NO_3-) into N_2 or nitrous oxide gases, and thus

removes N from the ecosystem. We investigated the denitrification potential of sediments from lakes surrounded by differing land uses (residential, golf course, or city park) and fed by differing water sources (groundwater, canal, and effluent) throughout the Phoenix metropolitan area. Contrary to our predictions, significant correlations between land use or water source and denitrification potential were not found, nor were potential rates correlated with nitrate concentrations. However, denitrification potential was correlated with chloride concentration and latitude, suggesting some influence of water source (chloride is a bioinert tracer) and perhaps larger landscape position on denitrification rates. Lakes are not a natural hydrologic feature of this arid region; all lakes in the area, now representing approximately 1% of the land cover, were created in the past 50 years. Whether these lakes act as significant sinks for N at the landscape level is unknown, but if the lakes are "hot spots" of denitrification they could account for some of the estimated N imbalance (inputs>outputs) in this urban area. Further investigation of controls on denitrification in urban lakes, and evaluation of their contribution to N removal in the landscape, will provide a key piece of information for the CAP LTER nitrogen budget.

Lemar, S.[1], C. Saltz[2], and M. Elser[2]. [1]Information Technology, Arizona State University, PO Box 870101, Tempe, AZ 85287-0101; and [2]International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211.
Middle school students performing university level environmental work.

During this past fall semester, 7th and 8th grade science students at Lowell School, in Phoenix, duplicated a land-use project developed at the International Institute for Sustainability. The students wanted to learn about land use in their immediate and surrounding areas. They first learned ArcView GIS and aerial photography interpretation and then utilized their new skills to create land use data for their study areas for the period from 1970-2005. Once the data collection was complete, the students were able to analyze changes that had occurred over the four decades and discuss why the changes had occurred. Finally, the Lowell students took a field trip to ASU where they presented their work and their conclusions to scientists from the International Institute for Sustainability.

Machabee, L., and A. Kinzig. International Institute for Sustainability, Arizona State University, PO Box 873211, AZ 85287-3211. ***Variations of landscapes preferences among Phoenix residents: A socio-demographic analysis.***

As it keeps expanding, the city of Phoenix is also becoming more diversified. People of different ages, incomes and ethnicities are reshaping its social composition. New

arrivals bring with them different recreational needs and residential landscaping models from other locations. These changes that are taking place in the Sonoran Desert, a fragile and complex ecosystem, pose significant challenges for recreation agencies and public managers. They must continue to meet the leisure needs of a diversifying constituency and also continue to make sound decisions about water/ land use and protection. A better understanding of people's parks and residential landscaping preferences may have important social and ecological implications. Critical information could be derived to enhance planning and decision making. This poster presents the results of research that documents the preferences of Phoenix residents for different types of open spaces. It signals the variations of preferences for different groups of residents and examines which social and demographic factors may explain these variations. The information presented allows one to capture the common characteristics of those for whom each park and residential landscapes meet their needs and preferences. A brief discussion follows, comparing the findings of this research with previous ones in the field of landscape perception and preferences.

Martin, C.[1], P. Warren[2], and A. Kinzig[3]. [1]Department of Applied Biological Sciences, Arizona State University East, 7001 E. Williams Field Rd, Mesa, AZ 85212; [2]Department of Natural Resources Conservation, Holdsworth Hall, University of Massachusetts-Amherst, Amherst, MA 01003; and [3]School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501. ***Tree composition in small urban parks and surrounding neighborhoods of Phoenix, Arizona.***

Composition of trees were evaluated during 2000 and 2001 within an array of 16, small urban parks (1.7-5.5 ha) and surrounding residential neighborhoods in Phoenix, Arizona, that spanned a range of socioeconomic rank (SER) and age. Parks were distributed within similarly dense residential neighborhoods of three SER, high, moderate, or low, and ranged in age from approximately 1950 to 1997. Counts of all trees in each park were made and neighborhood tree composition was approximated by counts along four transects distributed away from each park along streets in a northerly, easterly, southerly or westerly direction, respectively. Transect widths extended about the depth of a front yard residence on both sides of the street. Tree abundance in parks was positively related to the SER of surrounding neighborhoods, but tree diversity within all parks was similar. Park age had no impact on park tree diversity or abundance. Neighborhoods of high SER had greater tree diversity than neighborhoods of low SER, but tree abundance within all neighborhoods was similar. Neighborhood age had no impact on neighborhood tree diversity or abundance. The oldest neighborhoods and neighborhoods of lowest SER tended to have more trees from China and Australia, while newer neighborhoods and neighborhoods of highest SER tended to have more trees from Australia, South America, southeast Asia, and the Sonoran Desert. Older parks tended to have more trees from southeast and southwest Asia, China and the eastern US, and the

Mediterranean region, whereas newer parks tended to have more trees from Sonoran Desert, and nondesert regions of the southwest US. Parks in neighborhoods with high SER tended to have more trees from the Sonoran Desert and southwest Asia while parks in neighborhoods of low SER tended to have more trees from southwest Asia, nondesert regions of the southwest US, and Australia.

McCartney, P.[1], R. Quay[2], C. Gries[1], R. Schroeder[1], J. Hutchins[1], M. Zoldak[1], J. Zehnder[1], D. Mason[3], A. Bagley[4], and B. Griffin[5]. [1]International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; [2]City of Phoenix, 200 W. Washington, 6th Fl., Phoenix, AZ 85003; [3]Maricopa Association of Governments, 302 N. 1st Ave Ste 300, Phoenix, AZ 85003; [4]Arizona Department of Water Resources, 500 N. Third St, Phoenix, AZ 85004; and [5]Department of Family and Human Development, Arizona State University, PO Box 872502, Tempe, AZ 85287-2502. ***Integrating urban ecological models.***

Over the past 20 years, understanding of the functioning of urban ecosystems has increased to the point where fairly sophisticated models of various subsystems have been developed by scientists working for federal, state, and local agencies, often in cooperation with university researchers. Each is designed to collect data and explore a specific urban/environmental system for issues related to the mandate of the sponsoring agency. CAP LTER has recognized that these models are of value to science both for their insight into social and economic process and as potential media for ecological monitoring data to be represented in environmental and sustainability planning as well as decision-making.

One challenge facing us is the development of an information infrastructure that will facilitate the sharing of models among the diverse members of the urban ecological research community in central Arizona. In this project we build on prior work that established the Southwest Environmental Information Network to (1) establish a multi-agency network of metadata, data, and application services that can be invoked through an open, platform-independent messaging format and (2) enable the creation and execution of scenarios, or workflows, that loosely couple models by "piping" outputs of one process to the input of another – even if the two processes are running in different locations, on different operation systems, or in different languages.

As a test of this system, we have defined a workflow that links output from a global climate model and/or a household water use agent-based model to a hydrology model and then to a land-use change model. The workflow specifies the necessary transformation need to overcome scalar and semantic differences between the outputs of one model and inputs to another. A workflow-processing engine interprets the script and generates the specific calls to retrieve data, transform data, and execute models.

Moeller, M. S. International Institute for Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. ***Monitoring LULC dynamics in the Phoenix metropolitan area.***

The Phoenix metropolitan area belongs to one of the fastest-growing regions in the U.S., and only permanently acquired satellite remotely sensed image data can be used as an objective source for the documentation of this growth. Only satellite imagery provides a synoptic overview of the entire area at different times. A permanent acquisition of satellite data began in 1972 and the first image for the Phoenix area was recorded spring 1973. Over a 30-year time period seven satellite remotely sensed imagery sets from four different platforms and sensors have been analyzed using a segment-based, object-oriented approach. The classification scheme was adopted from the National Land Cover Data (NLCD). The resulting fine classification outlines the changes as a time series. A mesh with a 500 m × 500 m grid cell size has been overlaid and the major land use land cover (LULC) classes were assigned to each grid cell: farmland, urban, natural land. Combining these six layers to an animated image sequence, urban growth can be shown in a very impressive way.

Two main questions are interesting from a geographical point of view: where did the growth take place and at which time period? Can a specific growth pattern or decided rules be detected? An overlay with a wind rose scheme in a GIS environment should enable answering these questions.

As a center point for the wind rose, the 1973 centroid of the main Phoenix urban body has been chosen and then has been buffered with 50 fringes each in a distance of 1 km to its neighbor. The wind rose also consists of eight sectors each with a 45 degree angle (north to north east: sector 1, north east to east: sector 2, east to south east sector 3, etc.). In a next step the changes could be analyzed regarding their specific distance and their direction as seen from the city center in 1973.

Neil, K., and J. Wu. School of Life Sciences Graduate Programs, Arizona State University, PO Box 874601, Tempe, AZ 85287-4601. ***Urbanization effects on spatio-temporal patterns of flowering phenology of plants in the Phoenix metropolitan area***.

Research of the effects of urbanization on flowering phenology, i.e., the timing and duration of flowering, has shown that many spring-flowering plants are blooming earlier in urbanized areas than in the surrounding rural areas. The urban heat island phenomenon has been hypothesized to be a primary cause for change in flowering phenology. These studies have been conducted in temperate, Mediterranean, and boreal regions of North America, Europe, and Asia where the temperature-photoperiod interaction is widely accepted as the primary trigger of floral development under these bioclimatic conditions. While moisture and temperature are considered the primary triggers for most arid plants, flowering phenology in arid urban areas has yet to be studied. We propose to study the spatial and temporal

pattern of flowering phenology of three common plant species in the Phoenix metropolitan region. This will be done by field observations of selected plants at various sites across the city. We hypothesize that the pattern of flowering phenology of these plants will vary due to land-use heterogeneity, high night-time temperatures, and higher water availability. Two common indigenous species and one common nonindigenous species will be selected to represent allergen producers, food sources in the form of pollen for local bees and other insects, and an insect-pollinated nonindigenous plant. Therefore, the flowering phenology of these plants can be related to important ecological and human health issues.

Prashad, L.[1], A. J. Brazel[2], J. Golden[3], B. Hedquist[2], S. Harlan[4], and D. Sherwood[2]. [1]International Institute of Sustainability, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; [2]Department of Geography, Arizona State University, PO Box 870104, Tempe, AZ 85287-0104; [3]Director, Sustainable Materials and Renewable Technologies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211; and [4]Department of Sociology, Arizona State University, PO Box 872101, Tempe, AZ 85287-2101. ***Remote sensing and climate from north to south in CAP LTER.***

Environmental gradients or transects help to identify geographic changes in the environment and can be useful in identifying underlying processes at work in urban and rural environments. Often because of the lack of extant fine spatial resolution monitoring, especially in built up areas, sample transect approaches are often conducted by selecting a cross-sectional slice through variable conditions across the landscape. This presentation discusses a large north-to-south cross-section of the CAP LTER region using remote sensing of day and night images (surface temperature, SAVI, albedo), in situ weather station data, population and social data, and ancillary information concerning environmental conditions along the transect in order to further understand the role of topography, anthropogenic surfaces, and vegetative conditions on the variability of surface climate in urban, residential, and rural areas. The study ultimately aids in supporting decision-making processes in regards to mitigative strategies to optimize human comfort, reduce excessive extremes of surface heating and cooling, enhance sustainability of neighborhoods, and to advance ideas in the field of urban climatology and ecology. Emphasis is paid to identifying features, and their scales in the landscape, which represent large daytime and nighttime heated source areas, such as terrain, urban commercial and industrial zones, large outlays of asphalt such as parking lots and roadways, and other environments which may feasibly be targeted for mitigative and neighborhood strategies to enhance overall quality of life throughout the region.

Saltz, C.[1], N. Crocker[2], D. Taddy[3], D. Banks[4], and M. Elser[1]. [1]International Institute for Sustainability, PO Box 873211, Tempe, AZ 85287-3211; [2]University College, Undergraduate Academic Services Building, PO Box 873801, Tempe, AZ 85287-3801; [3]City of Phoenix - 200 West Washington Street,16th Floor, Phoenix, AZ 85003-1611; and [4]Innovative Tailor-made Technology and Training, 6395 Longcroft Dr, Oakland, CA 94611. ***Service at Salado, an urban environmental service-learning project***.

The overarching goal of the *Service at Salado* project is to create after-school clubs that engage children in a local environmental project while performing a valuable community service.

Service at Salado is a partnership between the International Institute for Sustainability and the University College. In addition to these internal partnerships, we collaborated with the City of Phoenix, Arizona Audubon Society and Valley View, Greenfield, Sunland, and Lowell Elementary Schools.

Service at Salado engages local schoolchildren in restoring and actively learning about a Sonoran Desert riparian area in the heart of the city. Students participate in The Phoenix Rio Salado Project, a city program that serves to revitalize the Salt River and provide a natural oasis accessible to city-dwellers.

The active learning strategies employed in *Service at Salado* follow the Arizona Department of Education Academic Standards in science, math, language arts, and social studies. Student investigations into the natural world increase the likelihood of their excelling in the classroom and becoming environmentally literate citizens. Middle-school students participate through after-school clubs in schools close to The Phoenix Rio Salado Project. Arizona State University (ASU) undergraduate and graduate students serve as role models for the middle-schoolers. By interacting with college students, the younger students will become more informed about ASU and the opportunities available to them.

Schaafsma, H., and J. Briggs. School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501. ***Legacies of farming in central Sweden: An archaeological perspective on modern plant communities.***

We measured legacies in modern landscapes that originated from three separate time periods, the study was conducted in central Sweden. In several locations temporally sequential agricultural fields are present and not overlapping on local landscapes allowing us to measure the rate of successional processes through the last 4,000 years. Farming has impacted the landscape in the study area since the Bronze Age 2000 BC-500 BC, through the Iron Age, 500 BC-AD 1000, the Medieval Period AD 1000-AD 1500 and into the early 1900's. In this study we include agricultural fields from the Bronze, Iron and Medieval Periods. Analysis of plant communities on fields from each of these times shows that legacies reflected in plant community compositions and cover persist on all of the fields. Fields from different time

periods show different types of legacies. These may be due to age differences or that different farming techniques in the various periods produced different types of legacies that have persisted through time.

This research provides insight into the degree to which humans have been significant drivers of landscape processes for thousands of years, the persistent nature of human impacts, successional processes and patch dynamics. Understanding the role of human decisions on the landscape can help us better plan our current and future choices towards a sustainable interaction with our environment.

Singer, C. K., and C. A. Martin. Department of Applied Biological Sciences, Arizona State University East, 7001 E. Williams Field Road, Mesa, AZ 85212. ***Effects of three landscape surface mulches on thermal processes in a drip-irrigated xeric landscape.***

Surface mulches are a common element of urban landscapes and are one of the seven principles of Xeriscape™. Most municipalities within the Phoenix metropolitan area have dust abatement ordinances that require applications of surface mulches to all bare landscape soil surfaces in public places. Inorganic mulches like decomposing granite are commonly used as landscape mulches in the desert Southwest. Organic mulches are less common in the Phoenix metropolitan area, but the availability of organic mulch materials is increasing. Recycling and reuse of waste products, such as timber residue produced by the logging industry and yard waste produced by the landscaping industry, is important ecologically for reducing landfill volumes. We compared the summertime thermal effects of three surface mulches, two organic (composted ponderosa pine residue and shredded urban tree trimmings) and one inorganic (Red Mountain Coral decomposing granite), and bare soil applied to 14 drip-irrigated xeric landscape research plots on below ground soil temperatures at depths of 5 cm and 30 cm, temperatures at the mulch-soil interface, mulch surface temperatures, diel mulch surface net radiation and albedo. Below-ground soil temperatures were more buffered by organic mulches and mulch-soil interface temperatures were lower under organic mulch than inorganic mulches. Inorganic mulch daytime surface temperatures were lower than organic mulch surface temperatures. Nighttime net radiation values were less negative over organic mulches than inorganic mulches and albedo was significantly higher for the inorganic mulch and bare soil treatments. These results provide evidence to show that organic surface mulches have higher resistances to heat transfer than inorganic mulches, which could improve summer landscape plant water and nutrient use efficiencies by lowering high summer root zone temperatures.

Singer, C. K., C. A. Martin and D. K. Mahkee. Department of Applied Biological Sciences, Arizona State University East, 7001 E. Williams Field Road, Mesa, AZ 85212. ***The legacy of former drip-irrigation and pruning practices on two landscape shrubs: Effects on growth rate and leaf morphology after two years.***

Phoenix metropolitan landscapes tend to be densely planted and heavily irrigated to encourage rapid vegetative cover after installation. As a result, landscape shrubs are chronically sheared into various simple geometric shapes. Over time, chronically sheared shrubs accumulate dead or bare stems with poor visual appearance. Landscape shrubs can be pruned to the ground to rejuvenate growth and appearance to improve this condition. However, growth rates after such severe renewal pruning may be dependent on previous irrigation and pruning practices that reflect a balance between rapid production of leaf area and efficient conservation of nutrients. In this study, growth rate and specific leaf mass (SLM; the ratio of leaf dry mass to leaf area) of *Nerium oleander* and *Leucophyllum frutescens* shrubs subjected previously to three years of differential irrigation rates (high and low) and four pruning frequencies (six weeks, six months, annually, or not pruned as control) followed by two years of annual severe renewal pruning; one year with differential irrigation (high and low) followed by second year with equivalent irrigation (low) were measured. After two years, growth and SLM of both shrub taxa was significantly affected by previous pruning practices, but not by previous differential irrigations. At the end of the second year, *Nerium* shrubs that had either been formerly pruned every six weeks or six months were smaller than those pruned annually or not pruned at all, while only *Leucophyllum* shrubs formerly pruned every six weeks were significantly smaller. SLM was highest for shrubs pruned annually and lowest for shrubs pruned every six weeks for both taxa. These results indicate a long-lasting hysteretic effect from previous pruning treatments on shrub resource acquisition and growth, especially those shrubs previously sheared as frequently as every six weeks.

Stutz, J. C.[1], R. J. Bills[2], J. R. Cousins[2], L. B. Stabler[2], S. Whitcomb[2], and C. A. Martin[1]. [1]Department of Applied Biological Sciences, Arizona State University East, Mesa AZ 85212; and [2]School of Life Sciences Graduate Programs, Arizona State University, PO Box 874601, Tempe, AZ 85287-4601. ***Arbuscular mycorrhizal fungi in the Phoenix metropolitan area: Diversity and functioning.***

AM fungi are obligate symbionts of many urban landscape plants and may be important factors in plant growth, nutrient status and response to biotic and abiotic stress. Prior to the onset of the Central Arizona–Phoenix LTER, little was known about the diversity and functioning of arbuscular mycorrhizal (AM) fungi in urban ecosystems. This poster will present research results from CAP1 on AM fungal diversity and functioning and indicate possible future directions for CAP2. AM fungal

species richness was found to be lower in the Phoenix urban areas in comparison to the surrounding Sonoran Desert. Factors that appear to affect species richness in urban areas include the presence of nonindigenous landscape plants, previous land use and time since land development. There is a significant overlap in AM fungal species composition between urban areas and the surrounding desert. Unlike birds and plants where many nonindigenous species inhabit urban areas, few nonindigenous AM fungal species have been detected. Mycorrhizal functioning may also be impacted by urban conditions. Landscape trees in residential landscapes were found to have lower levels of root colonization in comparison to trees in adjacent desert reserves. Landscape practices such as pruning and irrigation may have an impact on root colonization levels. Greenhouse experiments indicate that AM fungi can significantly increase the growth and carbon storage of landscape trees, although these effects were dependent on tree species and the source of the AM fungal community (desert versus residential). Possible future directions include using controlled experiments to determine linkages between mycorrhizal functioning and urban plant primary productivity and to test if alterations in AM fungal communities due to urbanization impacts mycorrhizal functioning.

Walker, J. S. School of Life Sciences, Arizona State University, PO Box 874601, Tempe, AZ 85287-4601. ***Birds of a feather: A story of urban and exurban avian population biology.***

The objective of this paper is to quantify the population distribution of three unique avian species using point-count data within the central Arizona Sonoran Desert, which encompasses the Phoenix metropolitan area. Bird count data were collected at 40 locations throughout the study region at eight different times corresponding with the seasons for two years. Three common and ecologically unique species were then selected out of this dataset to highlight the spatial patterns of how different species utilize the landscape as a whole. Two species were chosen to highlight the extremes of avian population segregation among urban and exurban land uses, Rock Dove (*Columba livia*) and Phainopepla (*Phainopepla nitens*), respectively. Experience has suggested that some native species penetrate the urban boundary and utilize its resources. Cactus Wren (*Campylorhynchus brunneicapillus*) was used as an example of a native bird species that tends to encroach into the urban environment. Population probability maps were created using the geostatistical interpolation method of indicator kriging.

Warren, P.[1], and E. Adley[2]. [1]Department of Natural Resources Conservation, Holdsworth Hall, University of Massachusetts-Amherst, Amherst, MA 01003; and [2]Purdue University, West Lafayette, IN 47906. ***Effects of predators and landscaping type on avian ground foraging behavior in Phoenix parks.***

Landscaping and land-use practices of humans have a profound impact on local ecological systems. Urban parks are one of the areas where these impacts are easily monitored. This study focused on two factors affecting bird behavior in urban parks in Phoenix: predator density and landscaping schemes. Ground foraging in open areas places individuals at high risk of predation. Accordingly, longer ground foraging sessions and longer distance from cover are expected with lower predator densities. Four xeric parks and four mesic parks were selected from the Phoenix metro area, controlling for differences in mean park size, neighborhood income level, and human population density. We observed foraging behavior for eight weeks in the summer of 2004. We conducted transects for domestic cats around each park. We compared time spent in the open and distance from cover to numbers of domestic cats as well as to presence of raptors and coyotes. Birds foraged on the ground for longer bouts in xeric parks. Cat presence and presence of two or more raptor species was correlated with a decrease in ground foraging times, while coyote presence was correlated with increased ground foraging periods. These preliminary data suggest that mesic and xeric landscapes may differ in predation rates on birds. All of these factors could be very helpful in understanding how choices in human land use can effect local avian populations.

White, J., and J. Stromberg. School of Life Sciences Graduate Programs, Arizona State University, PO Box 874601, Tempe AZ 85287-4601. ***Effects of river modification on the riparian soil seed bank of the Salt River, Arizona: A case study of an arid region river.***

Riparian ecosystems have been degraded in the southwestern US over the past century as demand for water has increased and driven the construction of dams and water diversion projects. The Salt River in Arizona is no exception. This once large perennial river has been reduced to a small ephemeral channel in places. Other reaches within the large urban center of Phoenix flow perennially and intermittently because storm drains provide runoff from a variety of urban sources. The flow regime of a river is an important ecological mechanism driving riparian plant community structure. Currently, there are several restoration projects of various scales being planned and implemented on the Salt River. No preliminary research has been conducted to determine the effects of flow regime alteration and watershed urbanization on the riparian plant community much less on the soil seed bank, which could provide a valuable yet inexpensive resource for revegetation. Studies on other rivers in the Sonoran Desert show that a large percentage of the riparian flora are seed-banking species, and that remnant floras may persist in the

seed banks of below-dam reaches. I am conducting a case study of the riparian soil seed bank along the highly modified arid region river, the Salt River, Arizona. I address several questions. How is the riparian soil seed bank affected by long-term river damming and diversion and by the return of flow and small flood pulses from constructed urban tributaries? How does the soil seed bank compare to the extant vegetation? What are the implications for restoration projects? To address these questions, I am analyzing the soil seed bank using the seedling emergence method and sampling the extant vegetation three times per year. I am contrasting results between reaches that differ in stream flow permanence, inundation frequency, substrate size, and water quality.