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

Urban Ecology and Sustainability

Twelfth Annual Poster Symposium
January 14, 2010
Carson Ballroom, Old Main

AGENDA

8:30 am **Coffee**

9:00 am **Welcome**
Nancy Grimm, Co-Director, CAP LTER and Professor, School of Life Sciences

9:10 am **Urban Nature's Services Infrastructure: Challenges in Implementation and Ideas of Nature**
Stephanie Pincetl, Director, The Urban Center for People and Environment, University of California-Los Angeles

10:15 am **Break**

10:30 am **Poster session #1**

11:30 am **Lunch, RSVP Required**
Global Institute of Sustainability, Room 481

12:00 pm **Research Meetings, Global Institute of Sustainability**
RSVP required, Rooms TBA

1:30 pm **Sustainability and Urban Ecology**
Maria Baier, Arizona State Land Commissioner

Charles L. Redman, Director, School of Sustainability and Co-Director, CAP LTER

Billie L. Turner II, Gilbert F. White Professor, School of Geographical Sciences and Urban Planning

2:45 pm **Break and Celebratory Cake**

3:00 pm **Poster session #2**

4:00 pm **Adjournment**

4:15 pm **CAP LTER Graduate Student Meeting**
Global Institute of Sustainability, Room 481

2010 CAP LTER Symposium

Posters are listed alphabetically by first author with poster location number in parentheses.

Poster Session #1	Poster Session #2
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Ahmad and Ruddell (35)	Boomgaard et al. (38)
Bleasdale et al. (3)	Cleland et al. (2)
Chuang and Redman (5)	Cook et al. (4)
Declet-Barreto et al. (15)	Davies et al. (24)
Kim and Wentz (7)	Dekatch et al. (38)
Loose et al. (29)	Fokidis et al. (26)
Martin (19)	Hamilton and Hartnett (6)
Romako (31)	Johnson, A., et al. (28)
Ruddell, Declet, et al. (17)	Johnson, J. C., et al. (30)
Ruddell et al. (23)	Langstaff and Elser (38)
Sampson (33)	Lerman et al. (32)
Shrestha et al. (9)	Lund and Shock (8)
Taylor et al. (13)	Marusenko and Hall (10)
Wong and Grimm (27)	Nakase et al. (12)
Zhang, C. et al. (25)	Shoumaker et al. (34)
Zhang, S. et al. (11)	Sweat et al. (14)
	Toke et al. (37)
	Turnbull et al. (16)
	Vandehei and Bateman (36)
	Warner and Kuzdas (18)
	Zhuo et al. (20)

LIST OF POSTERS

LAND-USE AND LAND-COVER CHANGES

Abrahams, Rachel, Rimjhim Aggarwal, and Carissa Taylor. ***Exploratory study on the spatial extent of locally oriented food production in Maricopa and Pinal Counties.***

Bleasdale, Tommy, Carolyn Crouch, David Miles, and Sharon Harlan. ***Participatory research in south-central Phoenix community-based gardening***.

Chuang, Wen-Ching, and Charles L. Redman. ***Monitoring 1985-2005 residential land-use and land-cover change in the Phoenix metropolitan area.***

Kim, Won Kyung, and Elizabeth Wentz. ***Understanding urban open spaces using a Green Index.***

Shrestha, Milan, Abigail York, Christopher Boone, and Sainan Zhang. ***Land fragmentation under rapid urbanization: A cross-site comparative analysis.***

Taylor, Carissa, Rimjhim Aggarwal, Hallie Eakin, and Katherine Spielmann***. Local food in the Phoenix metropolitan area: Barriers and enablers as perceived by food system stakeholders.***

Zhang, Sainan, Abigail M. York, Christopher G. Boone, and Milan Shrestha. ***Methodological issues in land fragmentation gradient analysis.***

CLIMATE-ECOSYSTEMS INTERACTIONS

Declet-Barreto, Juan, Anthony J. Brazel, M. Shimizu-Menke, Sharon L. Harlan, and the Sherman Park Neighborhood Association. ***Linking urban heat island research to community-based greening efforts: Collaborative research in community partnership.***

Martin, Chris A. ***Undercanopy and below ground microclimate patterns at the North Desert Village: 2007-2009.***

Ruddell, Darren, Juan Declet, Sharon L. Harlan, Susanne Grossman-Clarke, and Gerardo Chowell. ***Climate change in an urban desert: An examination of vegetation and local temperature variability in Phoenix, AZ.***

Ruddell, Darren M., Desirae A. Hoffman, and Omaya Ahmad. ***Historical temperature trends in Phoenix, Arizona from 1896-2009.***

Zhang, Chi, Nancy Grimm, and Jianguo Wu. ***Modeling the structure and functions of human-dominated terrestrial ecosystems with a hierarchical patch dynamics approach***.

WATER POLICY, USE, AND SUPPLY

Ahmad, Omaya, and Darren Ruddell. ***Balancing energy and water consumption in an urban desert environment: A case study on Phoenix, AZ.***

Loose, Jason, Amber Wutich, B. Crona, and Paul Westerhoff. ***Public perceptions of climate change and water scarcity in Phoenix, Arizona.***

Romako, David. ***Engaging Phoenix-area homeowners' associations for long-term volunteer environmental reporting with Arizona DroughtWatch.***

Sampson, David A. ***Differentiation in potential water savings from using reclaimed household grey water among Phoenix metro water providers; analyses from a new DCDC simulation tool.***

Wong, Christina P., and Nancy B. Grimm. ***Dynamics of urban water consumption.***

FLUXES OF MATERIALS AND SOCIO-ECOSYSTEM RESPONSE

Cleland, Robin, Ashlan Falletta-Cowden, Dorothy Ibes, and Sveinn Sigurdsson. ***An environmental justice and public health analysis of park use in South Phoenix.***

Cook, Elizabeth, Rebecca Hale, David Iwaniec, Jessica Corman, Xiaoli Dong, Genevieve Metson, and Jesse Sayles. ***Urban stoichiometry: An elemental approach to understanding human-environment interactions.***

Hamilton, Alex, and Hilairy Hartnett. ***Black carbon in urban/desert ecosystems.***

Lund, Tracy J., Everett Shock, and Panjai Prapaipong. ***Geochemical dynamics of a spring-fed stream in an arid climate.***

Marusenko, Yevgeniy, and Sharon Hall. ***The fate of PAH pollution deposition in urban desert soil.***

Nakase, Dana K., A. S. Hartshorn, and Sharon J. Hall. ***Assessing the human legacies on the development of semi-arid soils in central Arizona.***

Sweat. Ken G., Thomas H. Nash III, Panjai Prapaipong, and Paul T. Gremillion. ***Geographic patterns and temporal trends of trace metal deposition using the lichen* Xanthoparmelia *in Maricopa County, Arizona, USA.***

Turnbull, Laura, Daniel L. Childers, Rebecca Hale, and Nancy B. Grimm. ***Conceptualizing urban ecohydrological interactions and feedbacks.***

Warner, Benjamin, and Chris Kuzdas. ***Can the ecological resilience model effectively measure urban vulnerability?***

Zhuo, Xiaoding, Panjai Prapaipong, and Everett Shock. ***Evidence of arsenic accumulation in soils through irrigation in Maricopa County, AZ.***

HUMAN CONTROL OF BIODIVERSITY

Bang, Christofer, John L. Sabo, and Stanley H. Faeth. ***Emerging patterns from urban ecological field studies***.

Davies, Scott, Karen L. Sweazea, and Pierre Deviche. ***The influence of acute stress on glucose and protein utilization of a desert songbird.***

Fokidis, H. Bobby, Richard Sparr, Karen Sweazea, and Pierre Deviche. ***Species-specific habitat-associated changes in lipolytic metabolites during the avian stress response.***

Johnson, Amanda, Orenda Revis, and J. Chadwick Johnson. ***Chemical prey cues influence the urban microhabitat preferences of western black widow spiders,* Latrodectus hesperus*.***

Johnson, J. Chadwick, Lindsay Miles, and Patricia Trubl. ***The urban behavioral ecology of the western black widow* Latrodectus hesperus**.

Lerman, Susannah B., V. Kelly Turner, and Rebecca Watson. ***Suburban development with wildlife in mind: An investigation of homeowners' associations in Phoenix, AZ.***

Shoumaker, Tracy, A. Smith, C. Chambers, and Jianguo Wu. ***Effects of urbanization on bat community structure in the Phoenix metropolitan region.***

Vandehei, Nick, and Heather Bateman. ***Novelty responses of three bird species in a suburban desert habitat.***

EDUCATION AND OUTREACH

Boomgaard, Dave, and Monica Elser. ***Ecology Explorers: K-12 student contributions to the CAP LTER project: Westwood High School.***

Dekatch, Allison, Alinka Caponigro, and Birgit Musheno. ***Ecology Explorers: K-12 student contributions to the CAP LTER project: Desert Vista High School.***

Langstaff, Larry, and Monica Elser. ***Ecology Explorers: K-12 student contributions to the CAP LTER project: Hendrix High School.***

Toke, Nathan, Elizabeth Cook, Chris Mead, Kate Darby, J. Brian, Troy Benn, Christopher Boone, Stuart Fisher, and Steven Semken. ***Pedagogy in interdisciplinary higher education: An investigation of faculty and student perspectives.***

ABSTRACTS

All abstracts are listed alphabetically by first author. * indicates student poster.

*Abrahams, R., R. Aggarwal, and C. Taylor. ***Exploratory study on the spatial extent of locally oriented food production in Maricopa and Pinal counties***.

Local food is a growing trend in the United States. From the 2002 to the 2007 Agricultural Census, the number of farms participating in direct marketing rose 9%, and the value of agricultural products sold by farmers directly to consumers increased by 49%. Despite the growth of the local food sector in the Mountain West and the rest of the U.S., little research has been done to examine this phenomenon in Arizona. Utilizing survey data from a sample of local farmers, this exploratory study seeks to provide some preliminary insights as to the nature and extent of locally oriented, food-producing farms within Maricopa and Pinal counties.

Surveys were solicited from 55 Pinal and Maricopa food producers identified via online databases and through visits to farmers' market at which these farmers were selling to the local market. Those that responded provided information regarding farm acreage, ownership, products produced, farm production techniques, irrigation type, and marketing approaches. In general, the farms surveyed were much smaller than the average for the two counties, and only 63% of the farmers owned their land, as opposed to 93% of farmers in the state of Arizona. Despite their size, the farms produced a wide variety of crops – 66 varieties in total, and utilized a wide variety of environmentally sensitive and water-saving production practices. The most commonly used marketing technique was sales at local farmers' markets. A more formalized survey procedure, originating from a familiar source and timed in order to take advantage of an ideal season for approaching farmers both in and outside the farmers' market setting would be recommended as an ideal next step in this research. The authors are currently in the process of creating an online map of local food in the Phoenix metropolitan area. It is hoped that the publication, advertising, and use of this map could help build relationships with local farmers and encourage their participation in this research.

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*Ahmad, O.[1], and D. Ruddell[2]. ***Balancing energy and water consumption in an urban desert environment: A case study on Phoenix, AZ*.**

Three foremost challenges facing the rapidly urbanizing and naturally hot Phoenix, AZ, metropolitan area are the urban heat island effect, water supply, and energy consumption. The transformation of native landscapes into built environments and sources of anthropogenic heat have produced the heat-island effect (higher nighttime temperatures in cities compared to nearby native areas). Recent research shows local temperature variability within the urban environment is highly correlated with land use. Residential landscaping preferences, therefore, are a strong driver of local temperatures whereby households with high vegetation mitigate exposure to summer temperatures while drought-resistant landscaping increases exposure to heat stress, but is thought to help conserve water. An important consideration in this scenario is that households with drought-resistant landscaping are likely to have higher energy demands (to help provide cooling), and in Arizona, a considerable amount of water is required to generate electricity. Examining 16 diverse census blocks within the city of Phoenix, the present study utilizes four datasets to investigate the complex relationship between local air temperature, water use, and energy consumption. Surface air temperature is estimated using the Weather Research and Forecast climate model at a spatial resolution of 1km for a 2005 summer heat wave. Object-Based Image Analysis classification is used to calculate vegetation fraction using 2005 National Agriculture Imagery Project. The third and fourth datasets represent monthly water and energy consumption aggregated to the 2005 census block. Results quantify the direct and indirect costs of water and energy consumption and offer recommendations on water and energy policy.

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*Bang, C.[1], J. L. Sabo[1], and S. H. Faeth[2]. ***Emerging patterns from urban ecological field studies*.**

The Central Arizona–Phoenix Long-Term Ecological Research project is among the foremost institutions on experimental urban ecology in the world, and the growing metropolitan Phoenix area sets the stage for observing rapid changes to plant and arthropod communities. Our results from 10 years of monitoring arthropods, and 3 years of manipulation of plant productivity and arthropod communities in urban and desert areas, reveal patterns and processes typical for complex ecosystems. Urban areas are extremely heterogeneous combining different types of ground surface and vertical structures. Resource availability in terms of water and nutrients are found to vary with human social economy, in addition to fossil fuel pollution. Our results show that proximity to built structures affects plant productivity due to reduced wind speed, and variation in plant growth decreases in urban residential areas. This should create a more profitable environment for arthropods, which is reflected by higher abundance among ground-dwelling arthropods in mesic habitats. Vegetation-living arthropods however, are much less abundant than expected. We tested effects of bird predation, but did not find a significant impact.

We believe that the high number of exotic plant species, due to loss of native host plants, contribute to this altered state of arthropod communities. Arthropod diversity is highly variable depending on spatial association and habitat type. Desert remnant areas embedded in the urban matrix function as control sites for monitoring plant and arthropod communities, but they experience isolation effects as they increasingly become islands in the urban landscape. These findings are novel and may help us understand the consequences of current changes to human ecosystems.

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*Bleasdale, T. H.[1], C. Crouch[2], D. Miles[1] and S. L. Harlan[1]. ***Participatory research in south central Phoenix community-based gardening.***

This project is researching the real-world challenges of advancing community-based gardening programs and addressing the needs of community gardeners. We are working in partnership with the nonprofit Phoenix Revitalization Corporation (PRC) in Central City South (CCS). A multi-stage, multi-method approach is used to address sustainability challenges, including social and environmental justice, access to nutritious food, and community capacity building through expansion of community gardens in low-income neighborhoods. In the first stage, we initiated contacts with organizations and individuals in CCS neighborhoods through meetings and community events. Second, the PRC defined the needs and objectives of community gardens within the context of the community's larger vision of a resident-driven Quality of Life Plan and asked us to help them realize their objectives. In the third stage, we will collect and compile survey data about what advantages and disadvantages the community associates with gardening. We will use interviews and focus group sessions to fine-tune our understanding of community garden perceptions, asking what garden designs are preferred, what could be done to make community gardening more inviting and what disadvantages need to be overcome to expand the community-gardening program. The educational outcomes of the partnership will provide community gardening information, presentations and gardening strategies to the community and PRC. The data will be returned to the community along with informed strategies for expanding the gardening program. Further, our data will be used to support or challenge established theories of social and environmental justice pertaining to community gardening.

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*Boomgaard, D.[1], Westwood Students[1], and M. Elser[2]. ***Ecology Explorers: K-12 student contributions to the CAP LTER project: Westwood High School.***

Students in Dave Boomgaard's IB biology class at Westwood High School conducted a study on alternative-energy sources as related to photosynthesis. The project presented here focused on generating small amounts of electricity from

chlorophyll. This study was conducted during a three-week period in October-November 2009.

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*Chuang, W.-C., and C.L. Redman. ***Monitoring 1985-2005 residential land-use and land-cover change in the Phoenix metropolitan area.***

This study aims to examine the spatial patterns of urbanization in the Phoenix metropolitan area, especially for residential land use and land cover change from 1985 to 2005. In the past decades, urbanization has rapidly and profoundly changed the land surfaces. Previous studies have shown that in the past 30 years, of the land within metropolitan area that has been converted into some category of urban use, 54% was agricultural and 40% was desert land. Of the converted land, 70% has become residential areas. In addition, the urban expansion mainly occurred in the northwest and southeast parts of the Phoenix metropolitan area (Moeller unpubl.). Changes of land use and land cover, especially from the expansion of residential areas, directly impact ecosystem functioning, biodiversity, and local and regional climate. We believe that neighborhoods in different direction and distance from city center develop/change in different ways. Hence our analysis subdivided the study area (CAP region) into three cardinal quadrants, and subdivided them into five kilometer rings. Using the 1985-1995-2005 land-use and land-cover classification thematic layers, we quantified the change from non-urban areas to xeric and mesic residential areas in a 20-year time frame in high-growth areas. By tracking the changes and spatial patterns of residential areas with different landscape types, we are able to explain how neighborhood landscaping varies in different parts of the Phoenix metropolitan areas over time. Moreover, the result will be used to study how residential land covers affect the distribution of the urban heat island effect across the city.

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*Cleland, R.[1], A. Falletta-Cowden[1], D. Ibes[2], and S. Sigurdsson[1]. ***An environmental justice and public health analysis of park use in South Phoenix.***

This study investigates park use in South Phoenix from a public health and environmental justice perspective. A history of discriminatory practices has resulted in a concentration of low-income neighborhoods in South Phoenix who face a number of environmental justice and health challenges, including high rates of obesity. As research suggests that living within walking distance (400 m) of parks promotes physical activity and reduces rates of obesity, Cutts et al.[a] (2009) investigated the built environment of South Phoenix to determine if/how it contributes to vulnerability to obesity. Results revealed that, despite their high rates of obesity, South Phoenix residents do live in close proximity to parks and that their neighborhoods were walkable and promoted physical activity.

Our study seeks to shed light on this unusual finding by providing on-the-ground, quantitative and qualitative data about who uses parks in South Phoenix and how. We hypothesize that relative access to parks and walkability of neighborhoods may be offset by the quality of the parks; furthermore, low park quality and perhaps other negative social characteristics may affect park usage thereby negating any positive health effects these parks may be able to impart. We systematically characterized the built environments and users of five South Phoenix parks using SOPARC, a defined and tested protocol for cataloging park user and environmental characteristics. Results and implications related to public health and environmental justice are discussed.

[a]Cutts, B.B., K. J. Darby, C. G. Boone, and A. Brewis. 2009. City structure, obesity, and environmental justice: An integrated analysis of physical and social barriers to walkable streets and park access. *Social Science & Medicine* 69(9):1314-1322.

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*Cook[1], E., R. Hale[1], D. Iwaniec[2], J. Corman[1], X. Dong[2], G. Metson[2], and J. Sayles[3].

Urban stoichiometry: An elemental approach to understanding human-environment interactions.

Although urban areas cover less than 4% of the Earth's surface, they are key players in global biogeochemical cycles. Urban ecosystem ecologists have used nutrient budgets to understand the processes driving fluxes of carbon (C), nitrogen (N), and phosphorus (P) through cities. We integrate the concepts of nutrient budgets and ecological stoichiometry in order to examine how human activity and urban complexity may lead to novel biogeochemical patterns. Ecological stoichiometry has been applied in non-urban ecosystems to understand biogeochemical patterns, particularly nutrient limitation on growth and development. Sterner and Elser[a] (2002) hypothesized that human activities bring ecosystem scale stoichiometry closer to the Redfield ratio, but the processes underlying this pattern are unknown. While this suggests human activities may mediate coupled biogeochemical cycling, the degree to which urban biogeochemical cycling remains coupled is unknown.

Here we present our initial work to construct the first stoichiometric budget of an urban system. Using the Central-Arizona Phoenix ecosystem as our case study, we coupled existing C and N budgets, to our preliminary P budget. Our integrated approach is important for understanding urban biogeochemical processes and cross-scale interactions. We are interested in investigating changes over space and time and the social-ecological drivers mediating distribution patterns in cities. We are especially interested in exploring whether the biological concepts of stoichiometry and nutrient budgets can be linked and if they transfer to human-dominated systems. We suggest potential entry points for interdisciplinary applications with hope to motivate feedback and collaboration.

[a]Sterner, R. W., and J. J. Elser. 2002. *Ecological Stoichiometry: The Biology of Elements from Molecules to the Biosphere.* Princeton University Press.

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*Davies, S.[1], K. L. Sweazea[2], and P. Deviche[1]. ***The influence of acute stress on glucose and protein utilization of a desert songbird.***

An often-cited adaptive value of the avian stress response is the mobilization of energy stores to enable behavior aimed at increasing chances of survival. This mobilized energy is thought to come mainly in the form of glucose. However, this conclusion in birds is largely based on studies on captive European Starlings (*Sturnus vulgaris*) and no data are available for free-ranging birds. Studies in migratory birds also suggest that elevated plasma corticosterone, the primary stress hormone in birds, promotes protein utilization to enhance metabolic processes. Yet little data is available on the effect of acute stress on protein catabolism in wild birds. We investigated acute stress-induced changes in plasma glucose and uric acid, the end-product of protein catabolism, in free-ranging Abert's towhees, *Pipilo aberti*. We predicted that acute stress would not elicit hyperglycemia but protein catabolism would be enhanced leading to increased plasma uric acid concentrations. Consistent with studies of other captive birds, 60 minutes of handling and restraint did not induce hyperglycemia. However, acute stress resulted in a 43% decrease in plasma uric acid, indicative of decreased protein catabolism. Thus, the primary energy source mobilized in response to acute stress in birds may not be glucose or protein. Ongoing studies are aimed at determining whether acute stress promotes free fatty acid utilization.

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*Declet-Barreto, J.[1], A. J. Brazel[2], M. Shimizu-Menke[2], S.L. Harlan[1], and the Sherman Park Neighborhood Association. ***Linking urban heat island research to community-based greening efforts: Collaborative research in community partnership.***

Mitigation of the urban heat island (UHI) is one of the most pressing concerns of environmental scientists in urban environments. Recent research shows that vulnerability to the UHI is mediated by socio-economic status and the presence (or absence) of trees and grass in neighborhoods. Residents of the communities most affected by the UHI may have valuable insights about how increasing urban vegetation could improve their local environment and help mitigate extreme high temperatures. In this collaborative participatory research, we attempt to link UHI modeling to local knowledge in order to provide valuable information to a historically marginalized community in inner-city Phoenix, Arizona. In turn, researchers gain valuable knowledge from localized understandings of UHI dynamics. We conduct ENVI-Met microclimate simulations of urban canopy layer interactions with vegetation, soil, and surfaces during a recorded heat wave event. We first model surface, soil temperature and a thermal comfort indicator under the study area's mostly unvegetated conditions. We create a proposed vegetation regime based on residents' input regarding water use, tree species, and other thermal comfort considerations. We

then model the proposed vegetation conditions and compare the differences in temperature and thermal comfort.

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*Dekatch, A., A. Caponigro, and B. Musheno. ***Ecology Explorers: K-12 student contributions to the CAP LTER project: Desert Vista High School.***

Students from Birgit Musheno's sophomore biology class at Desert Vista High School conducted a backyard study of bird diversity as related to backyard vegetation. The results of their study are presented in this poster. The study was conducted during a four-week period in spring 2009.

Desert Vista High School, 16440 S 32nd St, Phoenix, AZ 85048

*Fokidis, H. B.[1], R. Sparr[2], K. Sweazea[2], and P. Deviche[1] ***Species-specific habitat-associated changes in lipolytic metabolites during the avian stress response.***

The physiological stress response enables an organism to mobilize energy (i.e., glucose) during a stressful event and during stress, glucose is partly produced by the breakdown of fat stores (i.e., lipolysis). Previous research showed Phoenix birds typically have a higher body condition (i.e., more fat stores) than desert birds and thus asked if they differ in how energy stores are used during stress. We measured changes in plasma metabolites, which either indicate lipolysis (triglycerides, β-OH-butyrate) or glycolysis (glucose, free glycerol) during stress in birds from human-associated habitats (urban, farms) and desert habitats. We predict urban and farm birds with greater food resource access will show lower reliance on lipolysis during stress (i.e., decreased triglycerides and free glycerol, increased ketones) than desert birds. This was partly supported for desert Curve-billed Thrashers (*Toxostoma curvirostre*), which depleted triglycerides and free glycerol, but also ketones, more than urban birds during stress. Farm House Sparrows (*Passer domesticus*) had higher ketones and triglycerides during stress than urban birds. Together these data suggest the current body condition of a bird reflects its habitat, and can alter how energy is mobilized during stress. Thus food resource availability can be a major factor influencing a bird's ability to overcome the stress of urbanization.

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*Hamilton, A.[1], and H. Hartnett[1,2]. ***Black carbon in urban/desert ecosystems.***

Black carbon (BC) is produced from the incomplete combustion of fossil fuels and biomass. BC is detected in many important geochemical pools (soils, sediments, aerosols) and is shown to be a significant portion of soil organic matter in some locations (45% in frequently burned soils). BC is ubiquitous in nature and its

presence in long-term carbon reservoirs is well documented. Sizable inputs of BC from both fossil fuel combustion and biomass burning make central Arizona a good location to investigate black carbon. Utilizing the CAP Survey-200 soil samples, 63 soil samples including desert and urban sites were analyzed for BC concentration and isotopic composition. Total organic carbon (TOC) of select soil samples was also analyzed using Fourier Transform Infrared (FTIR) spectroscopy and solid-state ^{13}C NMR.

Black carbon in central Arizona comprises between 0.02 and 0.78 % of the total soil mass and 1.65 to 62.86 % of the soil organic carbon (by weight). Urban locations have a higher concentration of BC than urban-fringe and rural soils, presumably because of the presence of automobiles. The ^{13}C isotopic composition of BC soil samples fall within the range from -10 to -20‰ which is different than the isotopic composition of the bulk organic matter (-20 and -24‰). New data from FTIR indicates a significant contribution of aromatic/aliphatic C, alcohol groups and ester groups to the total soil organic carbon. This analysis is currently being extended to assess chemical functional groups in black carbon.

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*Johnson, A., O. Revis, and J. C. Johnson. ***Chemical prey cues influence the urban microhabitat preferences of Western black widow spiders,* Latrodectus hesperus.**

Animals are known to utilize chemical cues in a number of functional contexts. For example, pheromonal cues have been clearly shown to shape many animal mating systems. In addition, the study of predator-prey dynamics is being revolutionized as we learn more about the capabilities of animals to use chemical information to avoid predators and/or locate prey. Such chemicals that allow one organism to exploit another are referred to as kairomones. Spiders offer a good model system for the study of kairomones as they are known to be important predators in terrestrial ecosystems, and several species have been shown to use chemical cues to avoid predators and/or locate prey. However, the extent to which chemical prey cues actually drive habitat use by many spider taxa remains unclear. Black widow spiders (*Latrodectus* spp.) are both a species of medical importance owing to the danger their venom presents to human victims and a common urban, agricultural and invasive pest species. In this study we used the western black widow, *Latrodectus hesperus*, to test the hypothesis that spiders are capable of detecting chemical cues left by potential prey items and adjust their habitat preferences (i.e., web-building behavior) accordingly. Our results showed a significant preference by black widows to build their webs in areas that contain chemical prey cues. We discuss the implications of this finding for our understanding of urban black widow habitat use, population dynamics and the potential for urban infestations.

Arizona State University at the West Campus, Division of Mathematical and Natural Sciences (2352), 4701 W. Thunderbird Rd, Glendale, AZ 85306

Johnson, J. C., L. Miles, and P. Trubl. ***The urban behavioral ecology of the western black widow* Latrodectus hesperus.**

The western black widow spider *Latrodectus hesperus* is a pest species of medical importance. Black widow populations from urban habitats of Phoenix, AZ, experience a drastically different environment than their counterparts from surrounding, undisturbed Sonoran Desert habitats. Specifically, urban populations tend to be densely populated (e.g., infestations) and are characterized by high prey abundance, low prey diversity, and low enemy risk. In contrast, desert populations tend to be sparsely populated and are characterized by low prey abundance, high prey diversity, and high enemy risk. Here we quantify a number of life history and behavioral variables across these populations to assess whether or not they are locally adapted to these ecological differences. In particular, we quantify the cannibalistic tendencies of these populations to test the two-tailed prediction that cannibalism may be heightened in urban populations due to high population densities and low prey diversity, or cannibalism may be reduced in urban populations due to relative food abundance and selection for increased social tolerance in dense congregations. Throughout we argue that an understanding of the impact urbanization has on local fauna is required if we wish to both reduce the impact we have on other organisms and reduce the risk that dangerous urban pests have on human populations.

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*Kim, W-K., and E. Wentz. ***Understanding urban open spaces using a Green Index*.**

Urban open space is a key component to sustainability living in cities because they provide both environmental and social benefits. The main objective of this research is to establish new delineation and measurement of open spaces to understand the multifunctional use and the full potential of open spaces in arid cities. Specifically, this research intends to define open spaces for arid cities using fuzzy set theory and to design a new approach for measuring the greenness and publicness of open spaces. To assign fuzzy membership values of urban open spaces, this research designs a new conceptual framework of "Green Index" and uses a mixed methodology to investigate open spaces.

First, object-oriented and per-pixel classification methods are used to extract land cover of trees, shrubs, and grass with Quickbird high resolution image. Second, classification data are corrected and have height levels of trees and public amenity information through field survey. Finally, the application of fuzzy logic is exemplarily described by means of a green index and other indicators of urban open spaces. The Green Index is a useful tool to quantify the greenness and publicness of urban open spaces in an arid city and to understand their functionality and quality with fuzzy set theory. This research provides an overview to understand urban open spaces using a green index and fuzzy set theory, and new delineation and measurement of urban open spaces can be a way to improve urban open space management considering water consumption and urban heat island mitigation.

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*Langstaff, L.[1], and M. Elser[2]. ***Ecology Explorers: K-12 student contributions to the CAP LTER project: Hendrix High School.***

Students from across the Phoenix metropolitan area have been involved in collecting population data in their schoolyards. Students from Larry Langstaff's class at Hendrix Junior High collected and analyzed schoolyard bird and arthropod data. Their results will be presented in their posters.

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*Lerman, S. B.[1], V. K. Turner[2] and R. Watson[2]. ***Suburban development with wildlife in mind: An investigation of homeowners' associations in Phoenix, AZ.***

Residential landscapes represent a significant part of urban areas and if managed collectively, can provide habitat for native wildlife. Increasingly, these landscapes are designed by private developers and managed by private entities called Homeowners' Associations (HOAs) through the authority of official Covenants, Codes and Restrictions (CCRs). Residential landscape form and management is the product of decisions made by multiple stakeholders and not exclusively controlled by individual homeowners. CCRs control elements of landscape structure such as plant materials and ground coverings (e.g., turf or gravel) and, by extension, HOAs may influence the structure urban bird communities. We investigate the landscape restrictions for neighborhoods with HOAs to evaluate the extent to which these restrictions influence bird distribution. We calculate native bird species diversity at the PASS bird monitoring locations. Eighteen of the 40 bird monitoring sites are located in neighborhoods with HOAs. For these 18 neighborhoods, we analyze landscape form and management practices based on CCRs.

If certain landscaping restrictions benefit native bird diversity, then these HOAs could act as a model for how HOAs can support biodiversity. Alternatively, some HOAs may not support native bird diversity. For these HOAs, identifying some of the confounding restrictions and then suggesting potential alternative landscaping practices would benefit the current and future HOAs by fostering the creation of residential landscapes desirable for both people and native wildlife. Integrating concepts from conservation biology with institutional analysis helps identify important stakeholders and evaluate their role in landscape planning and management. This research potentially identifies barriers to creating urban landscapes with high levels of biodiversity that may alleviate some of the negative impacts of urbanization.

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*Loose, J.[1], A. Wutich[2], B. Crona[3], and P. Westerhoff[4]. ***Public perceptions of climate change and water scarcity in Phoenix, Arizona.***

The Phoenix metropolitan area's rapid growth in the last 50 years requires it to reconcile an expanded population with an increasingly overburdened water supply. An understanding of the area's local ecological knowledge (abbr. LEK, knowledge and belief held by residents) may be important for effective ecological policymaking, because of LEK's central role in determining community and individual resource use. We examined two demographic variables: (1) length of residency in Phoenix and (2) urban as opposed to rural residency. We attempted to discover whether these two variables affect LEK surrounding local climate change phenomena and water scarcity in Phoenix. To do so, we interviewed residents in two Phoenix neighborhoods – one urban site and one rural site – and recorded their LEK of climate change and water scarcity using a free-list method. We then used statistical hypothesis testing to compare residents' LEK and test for significant differences along the above-mentioned variables.

Upon testing, we found that long-time residents and urban residents appear much more likely to perceive local climate change, when compared respectively to newcomers and rural residents. Neither length of residency nor the urban-rural divide appears to affect prediction of future water scarcity. However, perceptions of the underlying factors of local climate change and water scarcity appear to vary along both variables. These preliminary findings suggest that different Phoenix populations have distinct and divergent perceptions of the city's most pressing ecological issues.

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*Lund, T. J.[1], E. Shock[1,2], P. Prapaipong[1]. ***Geochemical dynamics of a spring-fed stream in an arid climate.***

A year-long study of major and trace element dynamics was conducted on Bonita Creek, a spring-fed stream flowing southward from the base of the Mogollon Rim near Payson, Arizona. The creek emerges from within or immediately above a limestone unit within the Permian Supai Formation and flows overland for about 2.5 miles to re-infiltrate as groundwater near the concealed contact between the Supai and Upper Pennsylvanian-Permian Naco limestone. Groundwater flows from Bonita Creek presumably re-emerge within the Verde River watershed, a major drinking water source for the Phoenix metro area. We installed an ISCO autosampler and YSI datalogging sonde to sample the creek and provide a high-frequency database and timeline of geochemical conditions. We also collected meteorological data from local USGS Hydrology stations, USDA SNOTEL sites, the Payson AZMET site and several residential weather stations. When the datasets are coupled, clear connections between snowmelt, precipitation events, seasonal dry-spells and elemental concentrations are visible. Snowmelt and snowmelt-derived dilution are clearly visible from the start of the study period through early April until snow-water equivalent measurements from area SNOTEL sites are zero. The lowest major ion (Ca, bicarbonate,

Na, Cl, K) concentrations occur during this time period. Then major ion concentrations increase from early April through the drier pre-monsoon months until mid-June, when concentrations reach a plateau and remain there until the first snows of December 2008. Monsoonal rainfall events have little to no long-term influence on major or trace element concentrations, but short term trends do somewhat resemble snowfall-snowmelt-induced seasonal trends.

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Martin, C. A. ***Undercanopy and below ground microclimate patterns at the North Desert Village: 2007-2009*.**

Undercanopy and below-ground microclimate measurements are continuously being monitored at the North Desert Village (NDV) long-term residential landscape experiment site in Mesa, Arizona. In this report, a comparison of patterns of above and below-ground temperatures, surface temperatures and soil moisture and heat flux at 30-cm depth at each of four treatment sites for three years (2007-2009) are provided. Soil temperatures were recorded using copper constantan thermocouples. Soil heat flux measurements were made using HFP01SC-L Hukseflux self-calibrating soil heat flux plates. Air temperatures and percent relative humidity were recorded by HMP 100 probes. These microclimate data were recorded every 5 minutes and averaged hourly by fixed solar-powered micrometeorological stations with a CR1000 datalogger that were located near the center of four of the five NDV treatment sites. The four treatment sites (average 6,177 m^2 area) with micrometeorological stations are called mesic (spray irrigated turf grass), oasis (a mixture of spray irrigated turf and drip-irrigated trees and shrubs), xeric (drip-irrigated trees and shrubs), and native (non-irrigated trees and shrubs). All landscape surfaces without turf grass are covered with 5 cm of light beige-colored decomposing granite mulch. Small differences in air temperature and percent relative humidity were observed at 2 m height. Differences in surface temperatures were consistently most correlated to surface cover type, and soils underneath turf covered surfaces were generally cooler and demonstrated the greatest diel (24 hr) variation in soil heat flux. At the residential yardscape scale, landscape vegetation composition effects undercanopy microclimate mostly below 2 m height.

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*Marusenko, Y. and S. Hall. ***The fate of PAH pollution deposition in urban desert soil.***

Human activity produces numerous chemicals that deteriorate environmental quality and can be harmful to humans. Polycyclic aromatic hydrocarbons (PAHs), are produced from incomplete combustion processes and are one of the most widespread compounds in the environment. Despite this significance, there is a considerable gap in our knowledge about the fate of PAHs that are diffusely distributed in

cities. At a global scale, literature reveals that the abundance and bioavailability of PAHs in soil is affected by factors such as climate, solar radiation, and traffic density. However, microbial activity may also influence the residence time of these chemicals in the environment, particularly in low-carbon desert soils. In our research, we ask, what is the magnitude, distribution, and fate of PAH pollution in an arid urban ecosystem? We collected 63 surface soil samples (0-2 cm depth) within 0.5 m of highways in the Phoenix metropolitan area. PAH concentrations in soils ranged widely, but on average are lower than in soils of other cities. Although the most likely sources for PAH content in roadway soils are vehicle emissions, PAH concentrations were not correlated with traffic density. Instead, concentrations were highly correlated with soil organic matter content, suggesting that PAHs in soils of desert cities may be controlled by factors associated with carbon retention, rather than the source of deposition.

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*Nakase, D. K. [1], A. S. Hartshorn[2], and S. J. Hall[1]. ***Assessing the human legacies on the development of semi-arid soils in central Arizona.***

Through collaboration with archaeologists, ecologists have been able to examine ecological impacts from human activity over time scales not available in modern global change research. This long-term record is especially important for understanding arid ecosystem dynamics that proceed slowly, such as soil development. Drylands compose nearly 40% of terrestrial land area and support 40% of the modern world's population. Arid ecosystems also supported large prehistoric human civilizations, such as those in the US Southwest that modified landscapes extensively to support crop production. Thus, research that integrates archaeological and ecological perspectives is necessary to understand the long-term, recursive relationship between humans and the arid environment.

Previous studies of Native American dry-land agriculture in the Southwest illuminate the fact that the long-term effects of the construction and farming of rain-fed terraces on soils vary widely based on topography, duration and intensity of cultivation and soil type. We know little, however, about the relative importance of the direct impacts (harvesting) and indirect impacts (topography change) of human activity on soil and ecological processes. To accomplish our research goal, we investigated deep soil properties (horizonation, pH, water holding capacity, soil nutrient pools) across a gradient of land-use intensity at Pueblo La Plata, a well-studied Native American settlement located on the semi-arid Perry Mesa in central Arizona. Preliminary results suggest that while humans farmed for up to 150 years on Perry Mesa, the alteration of topography which persisted 600 years after abandonment has had a greater legacy on soil processes in this semi-arid ecosystem.

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*Romako, D. ***Engaging Phoenix-area homeowners' associations for long-term volunteer environmental reporting with Arizona DroughtWatch***.

Drought is the most complex and wide-spread of natural disasters, but successful drought mitigation efforts require detailed and localized information, consistently collected over time. Arizona's DroughtWatch program was created by the Arizona Department of Water Resources to collect and aggregate this data, but has not successfully generated reports in urban or suburban regions of the state. The problem is not how to create more awareness of the program in these regions, but how to efficiently identify and engage those volunteers most likely to consistently report after having been made aware. I prioritize homeowners as the most efficient target demographic, and identify homeowners' associations (HOAs) as the most effective way to engage homeowners. While HOAs have a well-deserved reputation as bogeymen of conservation projects, the motivations for their opposition can be turned into the program's strengths. The four major obstacles – organization, distrust of government, green apathy, and antagonism to conservation efforts – should inform DroughtWatch's urban and suburban engagement strategy. Based on a broad literature review and a study of the most successful volunteer environmental monitoring programs in the country, I find that the key to ensuring long-term reporting is sense of ownership. This pride is first and foremost a belief in a private green oasis, not property values. I find that this suburban ideal, while often employed to oppose conservation programs, can be used to create demand for greater understanding of how drought affects homeowners' green spaces. While the strategies I identify are specific to Arizona DroughtWatch, the principles can be used by any conservation program that wants to build a partnership with homeowners.

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Ruddell, D.[1], J. Declet[2], S. L. Harlan[2], S. Grossman-Clarke[1], and G. Chowell[2].

Climate change in an urban desert: An examination of vegetation and local temperature variability in Phoenix, AZ.

Climate change represents one of the most challenging and important research topics of the 21st century. Rising global temperatures, particularly in urban areas, has prompted an influx of research not only on changes in physical conditions, but also on the increasing vulnerability of human health and well-being as a result of global and regional climate change. Recent studies indicate that temperatures vary significantly even within the same urban environment and that vegetation plays an important role in mitigating against warm temperatures in some urban areas while bare soil and impervious surfaces store heat, exacerbating high temperatures in other metropolitan areas. This poster reports on current research efforts investigating physical conditions of climate as well as human perceptions and experiences with heat stress while quantifying local vegetation among 40 neighborhoods throughout the Phoenix, AZ, metropolitan area. Our research indicates four critical points: 1) exposure to extreme heat is variably distributed among survey neighborhoods; 2) climate change is a social equity issue whereby some racial/ethnic groups are burdened with greater exposure and fewer resources to cope with extreme heat compared to others within the same study area; 3) public perceptions of climate

change correlate with environmental conditions at fine spatial scales of analysis; and 4) the relationship between physical elements of the urban landscape (i.e., urban vegetation, green areas) are strongly associated with exposure to extreme heat.

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Ruddell, D. M.[1], D. A. Hoffman[2], and O. Ahmad[3]. ***Historical temperature trends in Phoenix, Arizona from 1896-2009.***

The Phoenix, AZ, metropolitan area has experienced rapid growth since it was founded in 1868, particularly over the last 50 years. Located in the Sonoran Desert of the southwestern United States, Phoenix has the hottest climate of all major US metropolitan areas. As the population of Phoenix grows, implications of the urban heat island have been found to have significant impacts on human health and environmental systems. This study examines historical temperature records in Phoenix, specifically investigating the number of frost days (minimum temperatures <32°F), misery days (maximum temperature ≥110°F), and the threshold temperature of heat waves for temperatures recorded at Sky Harbor International Airport, and Phoenix's regional weather station from 1896 to 2009. This data is particularly useful to analyze trends in climate change such as increased or decreased temperatures, and predict how the trends will continue in the future. This study will provide insight into changes in the region's physical climate as well as assist in understanding the implications of urbanization on physical and social systems. Results indicate: 1) misery days are increasing over time; 2) frost days are decreasing during the same period of time; and 3) the intensity and duration of threshold temperatures are also increasing. This information is helpful in terms of improving urban planning, as well as understanding the impacts of a changing climate on human, environmental, and economic systems.

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Sampson, D.A. ***Differentiation in potential water savings from using reclaimed household grey water among Phoenix Metro water providers; analyses from a new DCDC simulation tool.***

Ongoing, transformative modeling efforts here at DCDC have yielded a new approach to integrative water policy and management for the Phoenix metro area. Our current provider-level water simulation model utilizes a multi-scale, multiple-platform modeling environment to estimate the water supply and demand for an array of Valley water providers for current and projected climate and population growth scenarios. In this contribution we examined the spatial and temporal distribution of potential water savings for 33 Valley water providers that could be realized following implementation of commercially available grey water recycling systems for residential use. Grey water consists of household (or commercial) water

which has not been contaminated by toilet discharge, and includes water from dish washing, laundry, and bathing. For these analyses we use current (consumption) and "delivered" gallons per capita per day (GPCD) as our water-savings metrics. Homeowners saved 11% to 12% of their average annual water use by recycling indoor grey water from domestic household use. Our current (consumptive) GPCD estimates based on population-density-water duty varied from a low of 147 for Valley utilities to a high of 1034 for Paradise Valley but averaged 285 when examined over all years and all water providers. Median GPCD for consumptive use was 224; Paradise Valley uses about 200 GPCD more water than Berneil, the second greatest water user in the Valley. Water savings as a result of grey water recycling decreased delivered GPCD by 18 to almost 120 GPCD, with savings increasing with annual total consumption.

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*Shoumaker, T.[1], A. Smith[1], C. Chambers[2], and J. Wu[1]. ***Effects of urbanization on bat community structure in the Phoenix metropolitan region.***

Bats are essential to the health of many ecosystems however, few studies have considered the effects of urbanization on bat activity. The objective of this study is to examine patterns of urban spatial heterogeneity at multiple scales and how these patterns affect bat activity in the Phoenix metropolitan region. Utilizing a landscape ecological approach, broad and specific measures will be used to characterize an indirect urbanization gradient. To elucidate characteristic scales at which bats perceive their environment, bat activity will be examined across three hierarchically nested scales: plot, patch and landscape. Using CAP LTER 200 survey points, stratified random sampling will be used to select a subset of monitoring sites in five land-use cover (LULC) types: disturbed (commercial/industrial), disturbed (residential), cultivated vegetation (agricultural), cultivated grass (golf courses) and undisturbed (native vegetation) within the Phoenix metropolitan region. Bat activity calculated for each land-use cover type will indicate the relative spatial distribution of bat activity in the Phoenix metropolitan region. Echolocation calls identified to the species level (presence/absence) will be tallied for each LULC type to indicate species richness. In addition, calls will be examined for feeding buzzes to determine sites where actual foraging activity is occurring and for which species. The author is not aware of any such studies conducted in the Phoenix metropolitan region and believes this will be an important first step in assessing the functional role of bat communities in urban ecosystems of the Phoenix metropolitan region.

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Shrestha, M.[1], A. York[2], C. Boone[3], and S. Zhang[3]. ***Land fragmentation under rapid urbanization: A cross-site comparative analysis.***

What are the patterns and processes of land fragmentation in the rapidly urbanized southwest US? This question is addressed in a cross-site study involving five

Long-Term Ecological Research (LTER) sites: Central Arizona-Phoenix, Sevilleta, Konza Prairie, Jornada Basin, and Shortgrass Steppe, where the impacts of rapid urbanization – mainly of sprawls, leap-frog developments, suburbanization and exurbanization – have been pervasive in shaping the landscape. Land fragmentation is one of such significant impacts in all these sites – albeit at different rates and with varying patterns, because it affects biodiversity and ecosystem processes as portions of the landscape become isolated without connecting corridors. In this study, we take a cross-site comparative approach to: (1) examine the land fragmentation patterns in the study sites, and (2) understand the roles of urban population dynamics, water provisioning, transportation, amenity-driven growth, and institutional factors.

Data used in this study are from the National Land Cover Dataset (1992 and 2001). We reclassified the original land cover classes into seven categories: developed (higher intensity), developed (lower intensity), agriculture, forest, undeveloped, grass/shrubland, and water. We also quantified the fragmentation patterns using landscape metrics: Patch Density (PD), Interspersion and Juxtaposition Index (IJI), Contagion (CONTAG), Landscape Shape Index (LSI), Edge Density (ED), and Shannon Diversity Index (SDI). We calculated these metrics for each site and then finally compared fragmentation patterns across study sites. We are currently analyzing the processes of land fragmentation, the roles of the proximate causes on land fragmentation, and its relationships with the ecosystem services.

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*Sweat, K. G.[1], T. H. Nash III[1], P. Prapaipong[2], and P. T. Gremillion[3]. ***Geographic patterns and temporal trends of trace metal deposition using the lichen* Xanthoparmelia *in Maricopa County, Arizona, USA*.**

The epilithic lichen *Xanthoparmelia* spp. was used to assess atmospheric deposition of trace elements for Maricopa County, located in central Arizona, USA The study area consisted of 27 locations in Maricopa County corresponding to a previous study, along with new locations added to increase spatial resolution. Long-term temporal trends were assessed using additional lichens collected from the region in 1970-1973, focusing on decreases in copper (Cu) and lead (Pb) from the closing of copper smelters and the phase out of leaded gasoline and increases in zinc (Zn). Comparisons were also made to lichens collected from rural areas in and around Grand Canyon Park, Arizona, and analyzed with the same techniques. Lichens were analyzed by both cold vapor technique for mercury (Hg) and wet digested in a high pressure microwave oven and analyzed by high resolution ICP-MS for a suite of trace elemental concentrations. Initial research suggests higher levels of almost all metals (anthropogenic and geologic) in Maricopa County. However, the highest locations for mercury were found in the northern areas, inside of the Navajo Nation at the sites closest to the Navajo Power Plant. Multivariate and spatial analyses are used to further explore trends in metal deposition.

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*Taylor, C., R. Aggarwal, H. Eakin, and K. Spielmann. ***Local food in the Phoenix metropolitan area: Barriers and enablers as perceived by food system stakeholders.***

Local food production and consumption are increasingly recognized as essential components of urban sustainability. However Phoenix, like many cities, is faced with a lack of information regarding its current local food system. The purpose of this project is to explore the nature of Phoenix's local food system as perceived by its producers, food-service providers, distributors and consumer representatives. Thirty key informant interviews were conducted with stakeholder representatives that offer unique perspectives as to the meaning of "local food" in Phoenix, and furthermore provide insights as to the barriers to and motivations for participation in local food networks.

In the key informant interviews, stakeholders most frequently cited "Arizona Grown" as an appropriate definition for local food in the region. Motivations for participation were diverse – consumers and distributors emphasized the importance of socially embedded values, such as supporting the local community; while producers and food-service providers tend to focus on the extra profit to be made from local products. Barriers experienced by the stakeholders were similar, but tended to be somewhat distinct from those often cited in other studies. The restrictive climate, and subsequently limited supply and concerns about environmental sustainability were the most frequently noted barriers, followed by issues related to inconvenience and lack of information about local food. Despite climate-related supply constraints, economic cost barriers, and the general inconvenience of participating in local food networks, many people seem strongly motivated to participate in the local food system in the Valley. Many interesting socio-economic questions regarding the affordability, profitability, and social equity of local foods emerged as a result of this study. Tensions between the need for an adequate, consistent food supply, issues with agricultural water use, and the pressure of development were all highlighted by the stakeholders. Pursuing additional research as to the feasibility and sustainability of the local food system, particularly in terms of reconciling the current system to the conflicting needs of its stakeholders will be crucial to its continued presence in the Phoenix region.

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*Toke, N.A.[1], E. Cook[2], C. Mead[1], K. Darby[3], J. Brian[2], T. Benn[4], C. Boone[4,5], S. Fisher[3], and S. Semken[1]. ***Pedagogy in interdisciplinary higher education: An investigation of faculty and student perspectives.***

Research and education are increasingly interdisciplinary as scholars seek knowledge and solutions that lie between disciplinary boundaries. Formal interdisciplinary education is becoming more common at many universities, including Arizona State University (ASU). In order to reflect upon the pedagogical shift toward interdisciplinarity, we conducted a qualitative study of interdisciplinary upper-level undergraduate

education at ASU. We present a comparison of student and faculty conceptions of interdisciplinary education and the associated uncertainties, goals, and challenges for each. We interviewed 20 faculty primarily from the Schools of Sustainability, Human Evolution and Social Change, and Life Sciences and surveyed 275 students from 10 of their classes. In addition we held three small student focus groups. Conceptions of interdisciplinarity were quite compatible among faculty and between students and faculty. However, analyzing the nuances in definitions reveals valuable information about institutional and pedagogical goals, tensions, and aspirations. Students and faculty agree that interdisciplinary learning requires a rigorous synthesis of knowledge. However, some students conveyed skepticism, noting interdisciplinary education might be diluting mastery of knowledge. While students and faculty in interdisciplinary classes shared the common goal of solving societally relevant complex problems, both are challenged by boundary work and uncertainty in pedagogical strategies and institutional structure. Students noted the difficulty in breaking away from seeking the 'right answer' and reciting facts. Faculty also expressed challenges in teaching students to "work outside of the boundaries… they've been taught", as well as finding a balance between depth and breadth of knowledge.
Note: this presentation is an extension from a similar abstract/poster presented at the 2009 annual Geological Society of America Meeting in Portland, OR. We plan to use the same poster with additional smaller prints to update new analyses/findings.

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Turnbull, L.[1], D. L. Childers[1], R. Hale[2], and N. B. Grimm[2]. ***Conceptualizing urban ecohydrological interactions and feedbacks.***

In urban ecosystems humans are exceptionally powerful mediators of change that greatly modify biotic and abiotic components of the environment. Urban ecosystems are characterized by multidirectional flows of water, matter, pollutants and energy. Many ecological studies carried out within urban ecosystems do not take these multidirectional flows into account and lack a theory of ecosystem function that explicitly takes spatial phenomenon into account. It is necessary to understand coupled ecological and hydrological processes beyond the traditional limits of spatial and temporal boundaries imposed by the study of hydrological and ecological processes in isolation from each other. Ecohydrology provides a useful framework within which the connectivity and feedbacks between coupled ecological and hydrological processes operating over multiple space and time scales can be investigated. In this study we conceptualize ecohydrological interactions over multiple space and time scales within the Phoenix metropolis. We consider explicitly the role of humans as ecosystem engineers and seek to determine how humans as ecosystem engineers alter hydrological processes and the resulting spatial and temporal scales over which ecohydrological processes occur.

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*Vandehei, N., and H. Bateman. ***Novelty responses of three bird species in a suburban desert habitat.***

Neophobia (the fear of novel objects) in birds is known to correlate with stability of their habitat. Birds in unstable environments tend to be neophilic; whereas, birds in stable environments are generally more neophobic. I investigated how three common species of birds responded to a novel feeding situation in a suburban neighborhood in Mesa. I predicted birds would not exhibit neophobia in an unstable desert, suburban environment. I present experimental evidence showing neophobia in Gambel's Quail and neophilia in the Abert's Towhee and Curve-billed Thrasher in a suburban neighborhood. For my methods, I placed various novel objects in close proximity to the feed, ranging from an orange traffic cone to oddly placed deer antlers. The average approach time for the Gambel's Quail when novel objects were present was 211 seconds. The Abert's Towhee had an average approach time of 8.6 seconds and the Curve-billed Thrasher's average approach time was 6.3 seconds. These results suggest that Gambel's Quail were more neophobic than other bird species in the same environment. My results suggest that Gambel's Quail are neophobic even in an unstable environment such as a desert neighborhood. This is most likely because quail are ground dwelling birds that must watch over an entire covey compared to the Abert's Towhee and Curve-billed Thrasher which arrive alone or in small groups.

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*Warner, B., and C. Kuzdas. ***Can the ecological resilience model effectively measure urban vulnerability?***

Vulnerability is often determined by the outcome of a linear analysis that characterizes stresses and subsequently determines impacts of these stresses. This approach is flawed when applied to socio-ecological systems because it does not treat cascading effects of hazards, it provides little detail on the hazard's causal sequence and it underemphasizes feedbacks beyond the system. Insights into the resilience of social-ecological systems incorporate complexity and add to a research agenda on the vulnerability caused by environmental and social change.

Resilience-based vulnerability assessment is a fundamental shift from steady-state vulnerability management; however, the resilience model is typically used to study the vulnerability of 'simple' socio-ecological systems. Cities are among the most complex systems in our world, therefore the model must be adapted to integrate the increased complexity. In this poster it is argued that urban vulnerability can be assessed and operationalized using the model of ecological resilience; however, modifications are needed to capture the complexities of cities. A framework is presented that allows categorization of urban subsystems thereby reducing complexity. The ecological resilience model is modified to allow individual subsystems within a city to move independently within a resilience landscape; however, linkages between subsystems are defined to capture interdependencies of subsys-

tems and feedbacks within cities. A distinction is made between 'static' and 'dynamic' interdependencies based on the interconnectedness between two subsystems. It is argued a subsystem can cross vulnerability thresholds without causing the entire urban system to shift regimes. Finally, a methodology is presented to allow city policy makers to quantify urban vulnerability and implement adaptations to reduce vulnerability.

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*Wong, C. P.[1], and N. B. Grimm[2]. ***Dynamics of urban water consumption.***

Cities possess high consumptive needs as centers of innovation and industry, often relying on distant resources for their developing economies. Freshwater provisioning is a key ecosystem service for all cities. Global analyses of water consumption typically occur at the country level, yet city behavior, particularly for cities in the developing world, can differ greatly from national norms. Transitioning to sustainable water management requires us to understand how the differing social, economic, and environmental conditions in cities influence urban water use. We assessed the influence of biophysical conditions, population size and growth rate, wealth, and national development context on urban water use for 103 international cities. City wealth was the most important determinant of urban water consumption. Population size was not significantly correlated to urban water use. Precipitation, runoff, and NPP were negatively correlated to urban water consumption. Lastly, consumption behavior at the city level differed from national expectations. Rapidly industrializing cities consumed water at quantities similar to US cities, whereas water use in European cities resembled that of cities in low and middle income nations. As urbanization continues into the future, achieving sustainable urban living will require accurate evaluation of the dynamic relationship between cities and the resources upon which they depend.

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Zhang, C.[1], N. Grimm[2], and J. Wu[2]. ***Modeling the structure and functions of human-dominated terrestrial ecosystems with a hierarchical patch dynamics approach.***

In order to address the structural and functional complexity of human-dominated ecosystems such as metropolitan region, a hierarchical patch dynamic ecosystem model (HPDEM) that couples the carbon/water/nitrogen processes has been developed. Ecosystem is modeled as interrelated subsystems that are in turn composed of their own subsystems, and so on, until the level of elementary is reached. In the elementary level of HPDEM, process-based plant physiological model is developed to simulate the ecological functions of individual plants. Above the individual plant level, five hierarchical levels, each of which is nested in the higher level, are modeled: plant population of the same functional type, land cover (or local ecosystem; e.g., yard or remnant forest in urban), land use with relatively stable land cover composition (e.g., residential area, park), landscapes (e.g., urban, agricultural land),

and region (e.g., metropolitan area) level. The biogeochemical processes of the metropolitan area are controlled/constrained by the multi-scale social-economic/ environmental factors such as the yard managements (land cover scale), municipal policy or community regulations (land use scale), urban-induced environmental changes (e.g., elevated temperature and nitrogen deposition) (landscape scale), land-use changes (e.g. urban sprawl and cropland abandonment) (regional scale), and global climate change (global scale). HPDEM aims to provide a tool for ecological extrapolation across multiple scales and also a flexible platform to study the responses of ecosystems to multiple anthropogenic stresses.

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*Zhang, S.[1,2], A. M. York[3], C. G. Boone[2], and M. Shrestha[1]. ***Methodological issues in land fragmentation gradient analysis.***

Landscape fragmentation has the potent to strongly influence ecosystems, environment, and society. In the study of land fragmentation, gradient analysis is an important method for effectively capturing the spatial patterns and dynamics of fragmentation for the whole landscape. Fragmentation gradients can be generated through a moving window (MW) approach using FRAGSTATS. In this study, we used FRAGSTSTS MW analysis to investigate spatial patterns of land fragmentation in the Metropolitan Phoenix Area based on National Land Cover Dataset (NLCD) for 1992 and 2001, and addressed some methodological issues in the analysis. First, through applying various MW sizes (from 30 m by 30 m to 1170 m by 1170 m), we examined the relationships between land fragmentation metrics and different window sizes, and found that the MW of 330 m by 330 m is optimal for the urban to edge area. Second, because urban sprawl usually takes place in a radial direction around the city center, this study also compared two popular methods of measuring fragmentation gradients at different distances from the urban center (using concentric rings from the city center and using a transect across the city center). Finally, the influence of thematic resolution on the pattern of fragmentation was also tested and is illustrated in the study based on two, three, and six land cover classes.

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*Zhuo, X[1], P. Prapaipong[2], and E. Shock[1,2]. ***Evidence of arsenic accumulation in soils through irrigation in Maricopa County, AZ.***

The Sonoran Desert climate is characterized by low precipitation, high temperature in the summer, and high evaporation most of the year. As a result, ionic species in soil solutions tend to reach high concentrations that can enhance the potential for adsorption onto mineral surfaces compared with soil-water systems in other climate settings. Our trace elemental analyses of 200 soil samples from Maricopa County (CAP LTER 200-point survey) reveal higher concentrations of arsenic in parts of the urban area that were used as agricultural land several decades ago. The concentra-

tion of arsenic in Verde River water is relatively high (5 ppb to 11ppb). Water from the Verde River was a major source of water used for agriculture since the time of the Hohokam. Patterns of elevated arsenic in soils overlap with both prehistoric and modern canal irrigation systems. Therefore, we hypothesize that the increase in arsenic in urban area soils results from the irrigation activities over many years. Preliminary arsenic adsorption experiments, using local desert soils that have no history of agriculture activity, show that large amounts of arsenic can be adsorbed (85% of 100ppb arsenic as arsenate in pH 8 solution and 55% for 10ppm solution). After the adsorption experiments, the soil was leached with 1% nitric acid for 1 hour, and only half of the arsenic adsorbed was released back to the solution, suggesting relatively strong binding between the arsenic and soil mineral surface sites. The adsorption potential of the desert soil is proved to be significant, and the accumulation of arsenic in river water on agricultural land is possible.

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