19th Annual

CAP LTER All Scientists Meeting and Poster Symposium

Friday, January 13, 2017

SkySong

ASU Julie Ann Wrigley Global Institute of Sustainability
Arizona State University

LTER

NSF

CAP LTER Nineteenth All Scientists Meeting
and Annual Poster Symposium
January 13, 2017
Synergy I and II, Building 3
Skysong, Scottsdale, Arizona

8:00 am Registration, coffee, and tea

8:30 am **State of the CAP LTER Site Address**
Dan Childers, Director, CAP LTER and Professor, School of Sustainability

8:50 am **Keynote presentation "Ecology for Cities" in Salt Lake City and Los Angeles Through the Lens of Ecological Planning and Design**
Diane Pataki, Professor, Department of Biology, University of Utah

10:15 am **Urban Infrastructure**
Nancy Grimm, co-Director, Urban Resilience to Extremes SRN and Professor, School of Life Sciences

11:00 am **Poster Session #1**

12:15 pm **Lunch**

1:30 pm **CAP Service Awards**

1:50 pm **Modeling the Urban Ecosystem**

Infrastructure as a Contributor to Social Vulnerability to Heat
Mikhail Chester, Assistant Professor, School of Sustainable Engineering and the Built Environment

Futures Scenarios - Impacts on Near-Surface Temperatures
Matei Georgescu, Associate Professor, School of Geographical Sciences and Urban Planning

Assessing the Role of Buildings in the Urban Climate
David Sailor, Professor, School of Geographical Sciences and Urban Planning

The Sustainable Futures Scenarios and WaterSim 6: Water Resource Policies and Pathways
David Sampson, Research Scientist, Decision Center for a Desert City

Land System Architecture & Urban Heat Island Effect
Billie Turner, Regents' Professor, School of Geographical Sciences and Urban Planning

3:10 pm **Poster Session #2**

4:30 pm **Adjourn**

2017 CAP LTER Symposium

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

Poster Session #1	Poster Session #2
Andrade, Riley, Larson, and Franklin (1)	Earl (2)
Andrade, Riley, Lerman, Warren, Bateman, Larson, and Ripplinger (3)	Handler, Suchy, Grimm, Palta, Childers, and Stromberg (25)
Ball, Hall, Heavenrich, and Ripplinger (5)	McPhillips and Grimm (4)
Caulkins, Palta, and Grimm (7)	Moen, Hackney, and Johnson (6)
Chipman, Stotts, Till, Larson, Wutich, and White (9)	Ramirez, Cook, Davidson, Grimm, and Iwaniec (8)
Clem, Childers, and Sanchez (11)	Sampson, Iwaniec, Davidson, and Cook (12)
Davidson, Cook, Grimm, and Iwaniec (13)	Sherpa and Shrestha (14)
DeMyers, Warpinski, and Wutich (15)	Smith, Li, and Turner (16)
du Bray, Wutich, and Brewis (17)	Sykes, Hutton, and McGraw (18)
Eller (19)	Teal, Polidoro, Rutherford, and Ball (20)
Flores, Eakin, and Baeza-Castro (21)	Templeton, Vivoni, Wang, and Schreiner-McGraw (22)
Gibbs, Peige, and Quay (23)	Urcuyo and Johnson (24)
Heavenrich, Shaw, and Hall (27)	Vega, Ball, Wickings, Christenson, Berry, Peters-Collaer, and Susman (26)
Kowal, Ball, and Marshall (29)	Wang, Upreti, Wang, and Yang (28)
Lee and Cheng (31)	Wheeler, Vivoni, and Hall (30)
Reichman and Rugland (10)	Wright, Chakalian, Kurtz, Watkins, Harland, Georgescu, and Hondula (32)

Speaker Bio

Diane Pataki

Professor and Associate Dean, Department of Biology, College of Science, University of Utah

Ecology for Cities" in Salt Lake City and Los Angeles Through the Lens of Ecological Planning and Design

Like Phoenix, Salt Lake City, Utah and Los Angeles, California face unprecedented challenges in maintaining functional green infrastructure and urban landscaping in the face of accelerating drought and climate change. LTER's "Ecology for Cities" framework of action-based ecological research integrated with the urban design process has provided opportunities for other groups to collaboratively re-shape greenspaces to meet these challenges. The Center for Ecological Planning and Design is implementing this approach in teaching, research, and practice at the University of Utah through design and planning projects aimed at 1) participatory, community-engaged greenspace planning, 2) collaborative teams of planners, designers, and researchers, and 3) designed experiments, monitoring, and adaptive management of new and retrofitted greenspace. Here we discuss two ongoing projects that adopt this approach: a riparian re-development plan in Salt Lake City and an assessment of the outcomes of recent drought-response policies in Los Angeles. These projects are aimed at identifying the most critical areas of scientific uncertainty that can likely lead to failures and unanticipated consequences of new urban design and planning projects without a collaborative and experimental approach coupled with careful monitoring. The initial results highlight the complexities and inter-connectedness of urban water systems, in which landscape water conservation measures and policies impact people and places in numerous ways, both desirable and undesirable. By greatly shortening the pathway by which new knowledge enters the planning and design process, ecological planning and design is intended to more effectively mitigate and avoid undesirable impacts of urban interventions than current drought response policy.

Biography

Diane Pataki is an ecologist who studies the role of vegetation in the functioning of cities. She is a Professor in the Department of Biology at the University of Utah with adjunct appointments in the Department of City & Metropolitan Planning and the Department of Landscape Architecture & Environmental Planning and Ecology Center at Utah State University. She also serves as Associate Dean of Students in the University of Utah College of Science. Prior to arriving in Utah in 2012, she was a faculty member at University of California, Irvine for 8 years where she was the founding Director of the Center for Environmental Biology and the Steele Burnand Anza Borrego Desert Research Center. She received a B.A. in environmental science at Barnard College and an M.S. and Ph.D. at the Duke Nicholas School of the Environment.

Pataki's work has spanned the impacts of climate change on ecosystems, the use of stable isotopes to study coupled human-natural processes related to urban CO_2 emissions, and the impacts of urban vegetation on local climate, pollution, and hydrology. She was the lead PI on an NSF Biocomplexity grant that focused on understanding CO_2 emissions in Salt

Lake City from 2002-2007. She was also funded by NASA from 1999-2003 to coordinate the Ecosystem Physiology program of the International Geosphere-Biosphere Programme's Global Change and Terrestrial Ecosystem (IGBP-GCTE) core project. In 2008 she was given the AGU Macelwane Medal for her contributions to geoscience in these areas. She followed this work with several NSF, EPA, and USDA funded projects that studied urban land-atmosphere interactions in Los Angeles while she taught at the University of California.

In Utah, Pataki has been a co-PI on an NSF EPSCoR Track I award focused on water sustainability in the Wasatch Front region (where Salt Lake City is located). She was also the lead PI on an NSF Water Sustainability and Climate grant, a co-PI on the Los Angeles NSF ULTRA-EX project on urban forest ecosystem services, and a co-PI on an NSF macrosystems project studying the ecological homogenization of urban America. She has served as a Program Director at the National Science Foundation and is Chief Specialty Editor for Urban Ecology at the journal Frontiers in Ecology and Evolution. Her work is focused on improving our mechanistic understanding of the interactions between vegetation, the physical environment, and urban planning, forestry, and design.

List of Posters

***Indicates student poster.**

ADAPTING TO CITY LIFE

***Moen, Claire E., Jennifer Hackney, and J. Chadwick Johnson. *The urban heat island's impact on ecdysone levels throughout development of western black widows*.**

***Smith, Jordan P., Xiaoxiao Li, and Billie L. Turner. *Lots of potential: Urban vacant land identification from high resolution remote sensing imagery*.**

***Sykes, Brooke, Pierce Hutton, and Kevin J. McGraw. *City living reverses the relationship between disease and color in a desert songbird*.**

***Urcuyo, Javier C., and J. Chadwick Johnson. *Urban heat island effects: How temperature influences male development and behavior in the western black widow spider*.**

CLIMATE AND HEAT

DeMyers, Christine A., Chloe L. Warpinski, and Amber Y. Wutich. *Urban water insecurity: A case study of homelessness in Phoenix, Arizona, USA.

du Bray, Margaret, Amber Wutich, and Alexandra Brewis. *Cross-cultural approaches to understanding the emotional geographies of climate change threats in four island nations.

Heavenrich, Hannah, Julea Shaw, and Sharon J. Hall. T*he role of abiotic factors in determining desert ANPP in a nutrient enrichment study across temporal and spatial scales.*

***Moen, Claire E., Jennifer Hackney, and J. Chad Johnson. *The urban heat island's impact on ecdysone levels throughout development of western black widows*.**

***Smith, Jordan P., Xiaoxiao Li, and Billie L. Turner. *Lots of potential: Urban vacant land identification from high resolution remote sensing imagery*.**

***Urcuyo, Javier C., and J. Chadwick Johnson. *Urban heat island effects: How temperature influences male development and behavior in the western black widow spider*.**

***Wang, Chenghao, Ruby Upreti, Zhi-Hua Wang, and Jiachuan Yang. *Impact of shade trees on urban hydroclimate for Phoenix and the continental United States*.**

Wright, Mary K., Paul C. Chakalian, Liza C. Kurtz, Lance E. Watkins, Sharon L. Harlan, Matei Georgescu, and David M. Hondula. *Extreme heat and power failures: Understanding household-scale risks.

EDUCATION AND MANAGEMENT

Earl, Stevan R. *The CAP LTER information management system: Data management for project investigators and the scientific community*.

*Eller, Maria S. *Ecology Explorers: Bringing CAP LTER research to community stakeholders.*

GOVERNANCE AND INSTITUTIONS

*Chipman, Danielle, Rhian Stotts, Charlotte Till, Kelli Larson, Amber Wutich, and Dave White. *Solutions for urban water sustainability transitions: Comparison of cities dependent on water from the Colorado River Basin*.

*DeMyers, Christine A., Chloe L. Warpinski, and Amber Y. Wutich. *Urban water insecurity: A case study of homelessness in Phoenix, Arizona, USA.*

*Flores, Shalae A. Hallie A. Eakin, and Andres Baeza-Castro. *Water conflict, social pressures and management.*

*Gibbs, Kyle N., Katie E. Peige, and Ray Quay. *Arizona's water crisis: Leadership*.

Reichman, Anne, and Erin Rugland. *ASU's Sustainable Cities Network*.

*Sherpa Sonam F., and Milan Shrestha. *Glacial lake outburst flood risks in the Everest region: Analyzing the governance and institutional factors of mitigation options.*

RESIDENTIAL LANDSCAPES AND NEIGHBORHOODS

*Andrade, Riley, Susannah B. Lerman, Paige S. Warren, Heather L. Bateman, Kelli Larson, and Julie Ripplinger. *How social and landscape characteristics affect the urban arthropod community during recessions*.

Ball, Becky A., Sharon J. Hall, Hannah Heavenrich, and Julie Ripplinger. *Long-term patterns in land use and soil properties across the CAP LTER ecosystem*.

McPhillips, Lauren E., and Nancy B. Grimm. *Cross-city comparison of green space distribution and characteristics*.

Reichman, Anne, and Erin Rugland. *ASU's Sustainable Cities Network*.

*Smith, Jordan P., Xiaoxiao Li, and Billie L. Turner. *Lots of potential: Urban vacant land identification from high resolution remote sensing imagery*.

*Sykes, Brooke, Pierce Hutton, and Kevin J. McGraw. *City living reverses the relationship between disease and color in a desert songbird*.

*Wheeler, Megan M., Enrique R. Vivoni, and Sharon J. Hall. *Evaluation of a soil water model to improve outdoor water use recommendations in an arid city*.

SCENARIOS AND FUTURES

***Davidson, Melissa, Elizabeth Cook, David M. Iwaniec, Marta Berbes, Matt Boylan, Matei Georgescu, Nancy B. Grimm, Scott Krayenhoff, Xiaoxiao Li, Ariane Middel, Brandon Ramirez, and David A. Sampson. *Exploring outcomes and assessing tradeoffs of co-developed sustainable future scenarios for the central Arizona-Phoenix region*.**

***Gibbs, Kyle N., Katie E. Peige, and Ray Quay. *Arizona's water crisis: Leadership*.**

***Ramirez, Brandon, Elizabeth Cook, Melissa Davidson, Nancy Grimm, and David Iwaniec. *Future sustainable scenarios for central Arizona-Phoenix region, designed and visualized with 3D modeling*.**

Sampson, David A., David Iwaniec, Melissa Davidson, and Elizabeth Cook. *Sustainable futures scenarios and WaterSim 6: Influence of alternative water supply policies on net potable water use.*

THE SALT RIVER

DeMyers, Christine A., Chloe L. Warpinski, and Amber Y. Wutich. *Urban water insecurity: A case study of homelessness in Phoenix.

Handler, Amalia M., Amanda K. Suchy, Nancy B. Grimm, Monica M. Palta, Daniel L. Childers, and Juliet C. Stromberg. *Nitrate attenuation pathways and capacity in urban wetlands of Phoenix, Arizona.

***Lee, Joomee, and Chingwen Cheng. *Land use patterns, water quality, and social vulnerability: A spatial analysis of Phoenix's drainage systems*.**

URBAN DESIGN

Andrade, Riley, Kelli Larson, and Janet Franklin. *Social-spatial analyses of attitudes towards the desert in Phoenix, Arizona.

McPhillips, Lauren E., and Nancy B. Grimm. *Cross-city comparison of green space distribution and characteristics*.

Reichman, Anne, and Erin Rugland. *ASU's Sustainable Cities Network*.

***Smith, Jordan P., Xiaoxiao Li, and Billie L. Turner. *Lots of potential: Urban vacant land identification from high resolution remote sensing imagery*.**

***Teal, Coby, Beth Polidoro, Richard Rushford, and Becky Ball. *Testing compost use in Phoenix city parks: Impacts on soil nutrients and biology*.**

WATER AND FLUXES

Ball, Becky A., Sharon J. Hall, Hannah Heavenrich, and Julie Ripplinger. *Long-term patterns in land use and soil properties across the CAP LTER ecosystem*.

Caulkins, Corey C., Monica M. Palta, and Nancy B. Grimm. *Effects of land use on denitrification potential in Oak Creek.

***Chipman, Danielle, Rhian Stotts, Charlotte Till, Kelli Larson, Amber Wutich, Dave White. *Solutions for urban water sustainability transitions: Comparison of cities dependent on water from the Colorado River Basin*.**

Clem, Bill L., Dan L. Childers, and Christopher A. Sanchez. *Soil nutrient and organic matter patterns in an aridland constructed treatment wetland.

DeMyers, Christine A., Chloe L. Warpinski, and Amber Y. Wutich. *Urban water insecurity: A case study of homelessness in Phoenix.

Flores, Shalae A., Hallie A. Eakin, Andres Baeza-Castro. *Water conflict, social pressures and management.

***Gibbs, Kyle N., Katie E. Peige, and Ray Quay. *Arizona's water crisis: Leadership*.**

Handler, Amalia M., Amanda K. Suchy, Nancy B. Grimm, Monica M. Palta, Daniel L. Childers, and Juliet C. Stromberg. *Nitrate attenuation pathways and capacity in urban wetlands of Phoenix, Arizona.

Kowal, Nikita B., Becky A. Ball, and Pamela A. Marshall. *Nitrogen deposition effects on microbial communities in desert soils.

Sampson, David A., David Iwaniec, Melissa Davidson, and Elizabeth Cook. *Sustainable futures scenarios and WaterSim 6: Influence of alternative water supply policies on net potable water use.*

***Teal, Coby, Beth Polidoro, Richard Rushford, and Becky Ball. *Testing compost use in Phoenix city parks: Impacts on soil nutrients and biology*.**

Templeton, Nicole P., Enrique R. Vivoni, Zhi-Hua Wang, and Adam P. Schreiner-McGraw. *Quantifying water and energy fluxes over different urban land covers in Phoenix, Arizona.

Vega, Miranda N., Becky Ball, Kyle Wickings, Lynn Christenson, Katlyn Berry, Steven Peters-Collaer, and Patrick Susman. *Pathways and patterns of plant litter chemistry throughout decomposition.

***Wheeler, Megan M., Enrique R. Vivoni, and Sharon J. Hall. *Evaluation of a soil water model to improve outdoor water use recommendations in an arid city*.**

Abstracts

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

***Andrade, R.[1], K. Larson[1, 2], and J. Franklin[1]. *Social-spatial analyses of attitudes towards the desert in Phoenix, Arizona*.**

Understanding what motivates urbanites to connect with the environment can facilitate the design of cities that are more ecologically and socially sustainable. Individual attitudes can influence land use, policy, and conservation initiatives while improving environmental quality and human well being. Although the importance of picturesque mountains and lush green forests has been well documented in the literature, less is known about the ways people connect to more arid landscapes. We used data collected in 2006 and 2011 from the Phoenix Area Social Survey to examine how interacting social and environmental characteristics affect residents' attitudes in metropolitan Phoenix. The primary research objectives of our study were to: (1) determine what factors shape attitudes towards the desert; and (2) identify how patterns of attitudes are spatially distributed and temporally differentiated throughout neighborhoods in Phoenix. Overall, social vulnerability was negatively related to attitudes towards the desert, particularly Hispanic ethnicity. There was evidence of a strong spatial clustering of positive and negative attitudes towards the desert. Concentrations of positive attitudes formed in northeast Phoenix, in neighborhoods of high socioeconomic status, with extensive desert landscaping, and in close proximity to desert preserves such as the McDowell Mountain Regional Park and Tonto National Forest. Negative attitudes were prominent in the southwest portion of the Valley, associated with a larger portion of Hispanic populations and more mesic neighborhoods. There are over 40,000 acres of desert parks and preserves in Phoenix, understanding residents attitudes towards the desert will help strengthen the connection between these areas and the local community, and advance the conservation of natural and cultural resources.

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Andrade, R.[1], S. B. Lerman[2], P. S. Warren[3], H. L. Bateman[4], K. Larson[1, 5], and J. Ripplinger[6]. *How social and landscape characteristics affect the urban arthropod community during recessions.

Residential yards reflect social status whereby neat and tidy yards indicate adherence to neighborhood expectations of promoting a well-maintained landscape. However, yard maintenance can be constrained by economic limitations and social factors such as foreclosures, which in turn affects urban biota. We connected long-term arthropod, vegetation, and social data from 2005-2006 and 2010-2011 to examine how the arthropod community in Phoenix changed over time in response to economic disturbance during the Great Recession (2007-2009). We asked: (1) How do arthropod diversity components change pre- and post-recession in Phoenix and what are the main drivers of this change? (2) How do arthropod communities compare across neighborhoods with varying social and landscaping characteristics? And (3) What are the linkages between social demographics, foreclosures, and landscaping, and how are they connected to the arthropod community in residential yards? We found that both arthropod diversity and abundance decreased over time and that there was a shift in the community to taxa that were associated with weedy neighborhoods and neighborhoods with a higher number of foreclosures. An ordination

analysis demonstrated that yard weediness, plant species richness, income, and length of residency were all important for structuring the arthropod community. The causal diagram that we developed to describe the system linked length of residency, socioeconomic status, and foreclosures to landscape structure in yards, which in turn predicted arthropod community outcomes. Overall, our research increases understanding of the complex linkages in socio-ecological systems and connects economic and social processes to ecological outcomes.

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Ball, B. A.[1]†, S. J. Hall[2], H. Heavenrich[2], and J. Ripplinger[2,3,4]. *Long-term patterns in land use and soil properties across the CAP LTER ecosystem*.

In urban ecosystems, enhanced nutrient inputs alter ecosystem processes such as rates of soil nutrient turnover and transformations among pools. Additionally, both climate and irrigation can be drivers of regional primary productivity and diversity. Therefore, it is likely that changes in climate, plant community diversity, and land use over the last decade will have significant impacts on soil properties and stoichiometry in the CAP LTER ecosystem. Numerous papers have explored the relationship between land use and soil properties at snap-shots in time, but no studies have yet explored change in soil properties through time, or linked long-term changes in soil properties to plant communities and climate. We synthesized the first 10 years of Survey 200 soil, plant, land-use, and climate datasets to answer the questions: (1) How do soil physical properties and chemistry change over time across different land-uses in the CAP ecosystem? (2) Are patterns in soil properties related to plant communities, and do these relationships depend on land-use? We found that many soil properties differ by land use. For example, compared to urban and agricultural soils, desert soils are sandier, denser and lower in pH, with lower levels of nutrients, carbon, and water. Past land use, particularly previous agricultural uses, also impacted these soil properties. Additionally, soil texture and several nutrient parameters changed over the 10 years of the study, and ongoing analyses will explore the correlated drivers for this change, including plant communities.

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***Caulkins, C., M. M. Palta, and N. B. Grimm. *Effects of land use on denitrification potential in Oak Creek*.**

Denitrification is a microbial process in which nitrate (NO_{3}^{-}) is reduced into dinitrogen gas (N_2). Previous work suggests that areas with high concentrations of ambient NO_{3}^{-} are likely to have higher denitrification rates than areas that are nitrogen limited. Our experiment, therefore, seeks to address how potential denitrification rates in Oak Creek (near Sedona, AZ) are influenced by a land-use gradient. We hypothesize that NO_{3}^{-} is an important limiting factor to denitrifiers in Oak Creek, and further propose that differences in NO_{3}^{-} inputs between land-use types result in differing rates of denitrification, with higher NO_{3}^{-} concentrations facilitating higher denitrification rates. Land use within the study area transitions from relatively undeveloped land north of Sedona to urbanized land in downtown Sedona, to agriculture (primarily vineyards) in Cornville, south of Sedona. We expect that agricultural land use generates the highest nitrate inputs into Oak Creek of the three land-use categories, and that these sections of the creek therefore have the highest potential denitrification rates. We expect that undeveloped land will show the opposite trend. In order to test our proposed relationship, we established two study sites in each land-use zone, collected sediment and water samples, and measured additional properties. We then used the sediments to perform a denitrification enzyme assay (DEA) in the lab, creating low-oxygen microcosms for each sediment type. Gas samples were taken from each microcosm at four different time points, capturing the change in headspace gas composition over time. Following sample analysis, we plan to assess significant drivers of potential denitrification in Oak Creek.

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***Chipman, D.[1], R. Stotts[2], C. Till[2], K. Larson[3], A. Wutich[2], and D. White[4]. *Solutions for urban water sustainability transitions: Comparison of cities dependent on water from the Colorado River Basin*.**

The Decision Center for a Desert City (DCDC) at Arizona State University was established in 2004 with an investment from the National Science Foundation through the Decision Making Under Uncertainty program. Now in its third funding cycle, DCDC III is focusing on transformational solutions for urban water sustainability transitions and has expanded its focus from the Phoenix metropolitan area to a wider comparison between Phoenix and two other cities dependent on the Colorado River: Las Vegas, Nevada, and Denver, Colorado. As a first step in understanding the actors, institutions, and governance structures that affect water decision-making in these three sites, as well as the history and possible future trajectory of transition strategies for sustainable water governance, this poster presents a preliminary comparison between the cities of interest. We explore the similarities and differences in water supply and demand, actors involved in water governance, and climate change threats, as well as basic demographics. Additionally, we focus on innovations in water management, focusing both on strategies to increase the water supply and reduce water demand.

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***Clem, B. L.[1], D. L. Childers[2], and C. A. Sanchez[2]. *Soil nutrient and organic matter patterns in an aridland constructed treatment wetland*.**

As urban areas increase in size and population, they face increasing pressure on resources, such as water. Cities are increasingly turning to “design with nature” solutions to overcome these challenges. Constructed treatment wetlands are a low-input solution to the challenge of urban water reuse. However, ecosystem processes in aridland constructed treatment wetlands, such as hydrology and plant nutrient uptake, perform differently than wetlands in mesic climates. However, how soil biogeochemical cycling in aridland wetlands may differ from their mesic counterparts is not well understood. In this study, we present 5 years of carbon (C), nitrogen (N) and organic matter (OM) data for soils in the Tres Rios Constructed Treatment Wetland in Phoenix, AZ, USA. Soil cores were collected annually at both ends of three marsh transects to capture variation from open water to marsh shoreline. These transects also represent a whole-system gradient from system inflow to outflow. Soils were ashed to determine OM content, and a Perkin-Elmer C-N Analyzer was used to evaluate C and N concentrations. Initial results suggest that concentrations of C, N and OM decreased with depth, following patterns reported in mesic wetlands and across the literature. However, C and N concentrations were greater at whole-system inflow and at the marsh-open water interface. Additionally, C, N and OM concentrations increased over time, suggesting gradual development of marsh soils. Further analysis will investigate possible mechanisms for the reported distributions of C, N, and OM.

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***Davidson, M. J.[1], E. M. Cook[2], D. M. Iwaniec[1], M. Berbes[1], M. Boylan[3], M. Georgescu[4], N. B. Grimm[1,5], S. Krayenhoff[5], X. Li, A. Middel[5], and D. A. Sampson[6]. *Exploring outcomes and assessing tradeoffs of co-developed sustainable future scenarios for the Central Arizona-Phoenix region*.**

Urban ecology can bring useful knowledge and perspectives on the future development of cities, but requires collaborative approaches to address city planning and management needs. We present a series of co-developed scenarios that explore alternative strategic, adaptive, and transformative futures and highlight the ways scenario approaches can be used as a tool for social-ecological-technological synthesis. Adaptive futures were developed to capture responses to extreme events. Strategic futures were projected forward using existing municipal goals and targets. Transformative futures were back-casted from radically transformed visions of sustainability. Co-developed scenario descriptions served as model inputs to explore outcomes and tradeoffs within and among the distinct scenarios. Specifically, through WaterSim parameterizations of single (e.g., stormwater capture) and synthetic variables (e.g. outdoor water use from alternative water sources), regional and microclimate heat distribution, and design-based representations of the scenarios we examined relationships between the social, ecological, and technical strategies used to achieve distinct scenario goals (i.e. adaptive, strategic, and transformative). Future workshops will focus on sustainability and resilience multi-criteria assessments to evaluate the scenarios based on model outputs. This project demonstrates how scenario construction and qualitative and quantitative assessments can enhance decision-making capacity for long-range sustainability planning.

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***DeMyers, C. A., C. L. Warpinski, and A. Y. Wutich. *Urban water insecurity: A case study of homelessness in Phoenix*.**

In this research project, we engage with the misconception that all people in the U.S. enjoy water security by examining the case of people experiencing homelessness in the city of Phoenix, Arizona in the southwestern United States. Persons who are experiencing homelessness are disproportionately at risk of dehydration and heat-related illness as they spend significantly more time outdoors and many have limited access to an adequate quantity of acceptable quality water. Our data was collected using archival data, participant-observation, focal follows with water distributors that serve homeless populations, and expert interviews with 14 diverse service providers. Our analysis follows this processual framework of water insecurity by focusing on the sources of water, the barriers to water acquisition, and the impacts of insufficient access for persons experiencing homelessness. In this analysis, we focus on people living in three situations: (1) shelters, (2) encampments, and (3) with no roof. We find that the different economic sectors of the homeless population are affected in different ways. For those in the shelter category, the major problem is water replenishment during or after long hours of exposure to extreme heat. For those in encampments, the major problem is increasing physical and social isolation as a product of encampment raiding. For those with no roof, the major problem is inconsistent and uncertain access to water fountains and water trucks. We also find many of the impacts of water scarcity lead back to the barriers to water acquisition, causing a cycle of water insecurity or homelessness. We conclude that persons who are experiencing homelessness have inconsistent and unreliable access to water for hydrating, maintaining hygiene, cooking, and cleaning for reasons that are largely social and structural.

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***du Bray, M., A. Wutich, and A. Brewis. *Cross-cultural approaches to understanding the emotional geographies of climate change in four island nations*.**

Climate change represents an unprecedented threat to the everyday lives of community members all over the world. Scholarly research has explored the anticipated biophysical effects of climate change in a variety of landscapes, as well as climate change belief among different communities. The role of gender is an important nuance arising from this work. Studying the interplay of emotion, gender, and climate change is important to understanding how lives are lived and experiences made in a changing world. As part of the 2014 Global Ethnohydrology Study, we interviewed 272 people in four island nations (United Kingdom, New Zealand, Cyprus, and Fiji) to understand how climate change was producing different emotional responses among men and women across and between these sites. Our data indicates that men are more likely to express anger, while women are more likely to indicate sadness. There are important consequences for these two emotions; while anger is more likely to act as a motivating force and lead to political action, consistent expressions of sadness may indicate important consequences for mental health, including depression and anxiety.

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Earl, S. R. ***The CAP LTER information management system: Data management for project investigators and the scientific community***.

Unprecedented amounts of information are available to investigators in our increasingly connected world. At the same time, there is a growing expectation of investigators to share not just their research findings but their research data as well (all CAP LTER investigators are asked to provide their research data upon conclusion of their investigation). The CAP LTER addresses the challenges of the long-term curation and dissemination of research data with a robust Information Management System (IMS) that benefits both CAP LTER investigators and the broader scientific community. The CAP LTER IMS facilitates the ingestion of research data and metadata that are housed in the CAP LTER and LTER Network data repositories, providing long-term storage and access to research data. Research data in these repositories are also cataloged by the DataONE federation, which greatly enhances their discoverability. Through these resources, data from the CAP LTER's long-term monitoring programs, and the work of previous investigators are available to the community as building blocks for future research efforts. Submitting data through the CAP LTER meets the data publishing requirements set by funders and publishers, and each data set is given a unique Digital Object Identifier (DOI) that a data provider may reference. The CAP LTER Information Manager and the GIOS Informatics Team are available to assist with the data publishing process, and to provide guidance regarding effective approaches to research data management to elevate the efficacy of both data publication and the overall research endeavor.

Julie Ann Wrigley Global Institute of Sustainability, Arizona State University, PO Box 875402, Tempe, AZ 852875402

Eller, M.** ***Ecology Explorers: Bringing CAP LTER research to community stakeholders.**

Ecology Explorers is a unit of the Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) program that develops urban ecology education materials based on CAP LTER and interacts with the public during outreach events in the Phoenix metropolitan area. As outreach implies, Ecology Explorers seeks to extend current research occurring at CAP LTER program out to the community. I explore how the Ecology Explorers program approaches education outreach at the local scale. First was recognizing what public outreach by the Ecology Explorers program includes: teacher instruction on environmental education, facilitated lessons in K-12 classrooms, and interaction with the general public at on- and off-campus events. During Fall 2016, community outreach included a water filtration lesson at Kyrene del Milenio Elementary School, decomposition lessons at Desert Shadows Middle School, and activities at South Mountain Environmental Education Center. The program's work demonstrates that residents of the Valley or Central Arizona-Phoenix are stakeholders of CAP LTER as the research taking place involves the urban ecosystem of which they are a part. Similarly, the Ecology Explorers program signifies the importance of bridging the academic sphere with the public sphere through environmental education. The lessons on what it means to live in an urban area within the Sonoran Desert both increase environmental and scientific literacy across all age-groups and contribute to the public's sense of place.

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***Flores, S.[1], H. Eakin[2], and A. Baeza-Castro[2]. *Water conflict, social pressures and management*.**

Protest has been both a practice of citizenship rights as well as a means of social pressure for change in the context of Mexico City's water system. This paper explores the role that citizen protest plays in the city's response to its water challenges. We use media reports of water protests to illuminate socio-political issues associated with the city's water problems, such as political corruption, gentrification, as well as general power dynamics and lack of transparency between citizens, governments, and the private business which interact with them. We code newspaper reports to analyze protest events in terms of the primary stimuli of water conflict, the areas within the city more prone to conflict, and the ways in which conflict and protest are used to initiate improved water management and to influence decision making to address water inequities. We found that water scarcity is the primary source of conflict, and that water scarcity is tied to new housing and commercial construction. These new constructions often disrupt water supplies and displace of minority or marginalized groups, which we denote as gentrification. The project demonstrates the intimate ties between inequities in housing and water in urban development. The study contributes to a larger NSF-funded project "MEGADAPT," which looks at the feedbacks and flows of social, institutional, hydrological, ecological processes in the vulnerability of Mexico City to water related stress.

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***Gibbs, K., K. Peige, and R. Quay. *Arizona's water crisis: Leadership*.**

Central Arizona faces a water crisis, not in the supply of water, but in a lack of leadership to plan future water policies. The baby boomer water experts are retiring at a rate that the new generations cannot keep up with. Decision Center for a Desert City (DCDC) is dedicated to inspiring and sustaining new generations of water leaders. DCDC has been creating and tuning the WaterSim model over the past ten years. WaterSim is a systems dynamics visualization tool that allows the user to learn about the effects of water polices on sustainability metrics in Maricopa County. In doing this, the user gains experience similar to that of an actual water manager and gains important knowledge in making water policy choices in the future. The Community Foundation recognized the potential in WaterSim and has given DCDC a grant of $100,000 to reach out to future community leaders. With this grant, DCDC has reached community groups (Arizona Hydrology Center, Valley Leadership) and university students at Arizona State University (Sustainable Cities) by deploying WaterSim as a web tool and organizing classes. In total, around 900 of future water leaders have been reached, 65 through community groups and around 800 through university classes. DCDC plans to reach more future leaders by reaching out to school districts and developing a media campaign to increase community involvement and awareness. Ultimately, DCDC plans to develop a sustaining strategy after meeting the goal of 800 to 1400 direct contacts reached.

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***Handler, A. M[1], A. K. Suchy[1], N. B. Grimm[1], M. M. Palta[1], D. L. Childers[2], and J. C. Stromberg*1. Nitrate attenuation pathways and capacity in urban wetlands of Phoenix, Arizona*.**

In the urban Salt River channel of Phoenix, Arizona, stormwater pipes drain runoff into the dry river bed, providing a new water source that sustains perennial wetlands. Water delivered by storm drains is enriched in nitrogen, particularly nitrate (NO_{3-}). However, these wetlands are not planned nor are they actively managed to reduce nitrogen loads. We investigated the microbial capacity of these wetlands to reduce NO_{3-} concentrations by examining surface-water (SW) and subsurface porewater (PW) chemistry and conducting soil incubations from dominant wetland vegetation patches. Nitrate was higher in SW than PW while ammonium (NH_4^+) was the opposite. Dissolved organic carbon (DOC) was abundant throughout the wetland, but was significantly higher in vegetated compared to non-vegetated patches. These data indicate conditions that support microbial NO_{3-} reduction, especially in vegetated patches. Laboratory incubations of wetland soil treated with a high (7 ppm) and low (1 ppm) dose of NO_{3-} consumed 0.191 ± 0.022 and 0.019 ± 0.005 mg N-NO_{3-} hr^{-1} kg wet $soil^{-1}$, respectively. A best-fit model showed incubations with a higher starting NO_{3-} concentration had a higher NO_{3-} loss rate and incubations from vegetated patches had a higher NO_{3-} loss rate than those from open patches. Across patches, NH_4^+ increased in the high treatment incubations, potentially indicating the presence of dissimilatory nitrate reduction to ammonium (DNRA). These results suggest the wetlands have the capacity to both remove nitrogen via denitrification and retain it via DNRA. This study indicates unplanned, unmanaged urban wetland systems have a high capacity to attenuate NO_{3-} delivered from the urban landscape.

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Heavenrich, H.[1], J. Shaw[2], and S. J. Hall[1]. *The role of abiotic factors in determining desert ANPP in a nutrient enrichment study across temporal and spatial scales.*

Annual plants play an important role in nutrient cycling in arid and semi-arid systems. The productivity of annual plants is driven by precipitation, nutrient availability, herbivory, and soil characteristics. However, the relative importance of each of these factors in driving annual plant growth can vary under the highly heterogeneous conditions that characterize desert systems. Understanding the importance and relationship of these drivers will enhance our ability to predict how annual plants in desert systems will respond to the effects of climate change and increased nitrogen deposition from human activities. In our study, we examined how precipitation, nutrient enrichment, soil properties, and patch-type (growing under shrub or open space) influence annual plant growth by measuring aboveground annual plant biomass across nine years at CAP LTER CNdep sites throughout the Phoenix metropolitan area. We found that 1) rainfall, nitrogen, and then phosphorous were the most important drivers of annual plant biomass, 2) WHC and rock cover both had significant effects on annual plant biomass, 3) the relative importance of factors varied depending on whether annual plants were growing under shrubs or in open spaces, and 4) annual plant biomass decreased over time even when controlling for rainfall (mean biomass (g/m^2): 2008-2010= 51.42 ± 8.3 and 2012, 2015, 2016 = 26.57± 4.2). This study emphasized the importance of both soil factors and biotic interactions in annual plant productivity. Using long-term data allowed us to parse out complex patterns, which will facilitate better predictions of how deserts will respond to nitrogen deposition and climate change.

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***Kowal, N. B.[1], B. A. Ball[2], and P. Marshall[2]. *Nitrogen deposition effects on microbial communities in desert soils*.**

With rising populations, human activity is directly increasing the amounts of nitrogen in the atmosphere. Maricopa County has seen an increase of 7.1% from 2010-2014 alone. This study explored the impact of this increasing population on the environment in and around it. The purpose of this research is to show how nitrogen deposition affects microbial communities in desert soils around the Phoenix metropolitan area. The aspects of examination consisted of microbial growth in carbon-utilization plates from soil samples taken from the inner-city (higher nitrogen deposition) and outer-city (lower nitrogen deposition) from either control plots or plots receiving addition nitrogen. This was factored with the biogeochemistry of the soil samples, such as the texture, moisture factor, and conductivity, and phosphate, nitrite, nitrate, and ammonia levels and analyzed through Principle Component Analysis. Results showed that there were no significant differences in these microbial communities despite the different levels of soil nitrogen. This shows that the nitrogen deposition increase may not be as significant to the growth and diversity of microbial communities in soil as some other factor, such as precipitation, may have on these microbes.

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***Lee, J.[1], and C. Cheng[2]. *Land-use patterns, water quality, and social vulnerability: A spatial analysis of Phoenix's drainage systems*.**

Nearly half of the Phoenix metropolitan area is dominated by urban land uses. Impervious land cover associated with urban land uses have contributed to increased stormwater runoff and degradation of water quality. About 12.6% of the population in the City of Phoenix is considered under high vulnerable status in socioeconomic aspects (i.e., poverty, employment, Income, education). The degradation of environmental quality and high social vulnerability pose threats to Phoenix's sustainability.

This study aims to investigate the relationships between land-use and land-cover patterns, water quality, and social vulnerability within four urban drainage-sheds along the Salt River in Phoenix. Statistical analyses, GIS, and FRAGSTATS were employed to construct correlation between land-use patterns, water quality, Social Vulnerability Index, drainage boundaries, and landscape indices of land-cover spatial patterns.

The results demonstrate that the amount of vegetated land covers and their dispersed small patches are positively associated with water quality. In addition, water quality is negatively associated with higher social vulnerability populations who also have less access to the amount and dispersed small vegetated land cover patterns. Our study suggests the needs of strategic green infrastructure planning and urban design in consideration of urban hydrological condition to address both water quality and environmental justice in cities.

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McPhillips, L. E.[1], and N. B. Grimm[2]. *Cross-city comparison of green space distribution and characteristics*.

Vegetated or “green” spaces in cities can potentially provide a wide range of benefits, such as stormwater absorption and mitigation of urban heat. As we face more extreme weather events in the face of climate change, green spaces will be an important strategy for helping to manage the impacts of these events. In the Urban Resilience to Extremes Sustainability Research Network (UREx SRN), we are comparing the distribution and various characteristics of green spaces in several cities across the US and Latin America, including Baltimore, New York, Phoenix, Portland and Syracuse. To characterize green space, we used high-resolution land cover data derived from satellite imagery in each city. We compared the size and spatial distribution of green patches across the cities and also compared the green spaces to spatially explicit data on socioeconomic and biophysical characteristics. Preliminary data indicate that Phoenix has less than half the green space of the other cities (12% by area), though there is still substantial variability in coverage of the more humid cities (39-56%). Phoenix green space is also dominated by small parcels. Green space relationships with median income indicate fairly equitable distribution in Phoenix, whereas Syracuse has lower green space coverage in poorer neighborhoods. Using this knowledge on how green spaces have been implemented in the past and by learning from other cities, we can inform future planning and build more resilient cities.

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***Moen, C., J. Hackney, and J. C. Johnson. *The urban heat island’s impact on ecdysone levels during development of western black widows*.**

Ecdysone is a steroid hormone that controls molting in insects and other arthropods. While ecdysone is the direct initiator of molting, the actual timing of the molt is regulated by other hormones and environmental factors. For example, temperature increases often accelerate development in arthropods. In cities, the capture of heat by built structures (i.e., urban heat island) is an environmental factor that can increase temperatures. Recent field studies of arthropod microclimates show average nighttime temperatures in urban Phoenix to be 33°C, which is drastically higher than the nighttime desert temperature of 27°C. The western black widow spider, *Latrodectus hesperus*, thrives in urban habitat; yet, our work shows that urban temperatures actually slow egg and spiderling development and reduce body mass and increase mortality of early stage spiderlings. Here we look at the relationship between ecdysone levels and development in spiderlings experiencing urban and desert temperature conditions. Concentrating on four families collected from urban Phoenix habitats, we tracked ecdysone levels from day 44 through day 72 of development for spiderlings raised at 27°C and 33°C. We found that spiders raised at 33°C consistently have higher ecdysone levels throughout development. On average, the urban temperature conditions raised ecdysone levels to be 9 times higher across all spiderlings, with familial differences ranging from 3-30 times. These findings suggest that the urban heat island hyperstimulates ecdysone, disrupting development and the critical molting process of the black widow. We discuss the implications for these findings given the black widows emerging role as an urban pest of medical importance.

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***Ramirez, B.[1], E. M. Cook[2], M. J. Davidson[3], N. B. Grimm[1,4], and D. M. Iwaniec[3].** ***Future sustainable scenarios for central Arizona-Phoenix region, designed and visualized with 3D modeling*.**

Cities are facing new and complex future challenges. Participatory scenario development is one strategy to build capacity with local stakeholders to develop innovative solutions. Each scenario richly describes different strategies, priorities, and land development to address urban sustainability challenges. Abstract visualization of the co-developed future scenarios and the unbuilt environment can be difficult, but is an important tool for exploring each scenario. Visualizations help compare and contrast certain tradeoffs and original characteristics ranging from plant canopy cover to building materials between the scenarios. We co-developed a series of six different scenarios through collaborative workshops with local community, municipal, and academic stakeholders. The scenarios include: adaptive scenarios, which responded to extreme weather events (i.e., heat, drought, and flood); transformative scenarios were developed from revolutionary future visions of sustainability. Comprehensive scenario descriptions developed in the participatory workshops were used to develop 3D model visualizations of the iconic features of each scenario. These models are animated through a series of design tools and begin to take on a more tangible characteristic once visualized. These models convey the unique aspects and data that generate each scenarios differing storyline. For example the Emerald City scenario visualization highlights a highly vegetated city with an extreme reduction in roadways while the Zero Waste scenario highlights a reuse of salvaged materials to construct buildings for new communities and offices. Each modeled visualization adds a new element to the development and construction of sustainable future scenarios and broadens engagement opportunities for CAP LTER research and long-term sustainable planning.

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Reichman, A., and E. Rugland. ***ASU's Sustainable Cities Network*.**

The Sustainable Cities Network, an award winning outreach and education program within the Julie Ann Wrigley Global Institute of Sustainability, convenes communities across Arizona to further urban sustainability. The Network serves as a bridge between Arizona State University's multi-disciplinary research and technical capabilities and the front-line challenges facing local communities. Created in 2008 to strengthen regional sustainability efforts, SCN is a voluntary, no-cost network that includes hundreds of practitioners from cities and towns, counties, tribal communities, and many nonprofit organization partners from the Phoenix Metro area and throughout Arizona. Member communities share knowledge, resources, and solutions to make sustainability a core value in community planning, operations, and policy development. To do this, the Network hosts educational workgroups, regional meetings, training workshops, events and activities, partnership projects, and ASU engagements to facilitate information sharing and collaborative activities and outcomes. Additionally, the Sustainable Cities Network is spearheading a new university-community partnership program, Project Cities, to improve educational opportunity for ASU students while providing needed technical assistance to neighboring cities. Project Cities will allow ASU classes across academic disciplines to work on city projects such as strategic plans, economic development, or environmental conservation, providing both professional experience to students and additional assistance for city staff and departments. This poster is an overview of the Network and includes information about Project Cities.

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Sampson, D. A.[1], D. Iwaniec[1], M. Davidson[1], and E. Cook[2]. *Sustainable futures scenarios and WaterSim 6: Influence of alternative water supply policies on net potable water use*.

There are multiple paths to a sustainable water future; potential, viable pathways combine multiple perspectives such that each scenario may provide unique possibilities. The Sustainable Futures Scenarios Initiative continues to bring together a diverse group of academics and decision-makers in the water resource arena in an attempt to forge creative water futures based on current and potential policies and infrastructure decisions. WaterSim 6 was written to include new water policies such as rainwater harvesting, storm water capture, and water demand estimates based on land-cover land-use change. We parameterized the model to simulate seven distinct scenario futures defined in the project; three adaptive, three transformative, and one strategic (a progressive "business as usual") scenarios provide a range of potential water futures for the Phoenix Metropolitan Area (PMA). For this poster we focused on three: the Adaptive Drought (AD), Emerald City (Emerald Necklace) (EC), and Strategic scenarios. The AD scenario is characterized by creating or enhancing alternative water sources (rainwater, storm water, water augmentation, and banked water), reducing leaks, and shifting effluent use to groundwater recharge. The EC scenario focuses on land conversion to decrease impervious surfaces (increase infiltration), capture of storm water, and gray water reuse. In this work we examined the contributions from non-potable water for meeting outdoor water demands, and the resulting effects on net water demand and potable water used from traditional water supply sources in the PMA. We found that non-potable water can account for 7% to 40% (or more) of outdoor water demand depending on rainfall.

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***Sherpa, S. F., and M. Shrestha. *Glacial lake outburst flood risks in the Everest region: Analyzing the governance and institutional factors of mitigation options*.**

Several Himalayan glacial lakes are expanding rapidly due to global warming, and some pose direct threats to the downstream communities. These lakes may seem far removed from urban system research, but the risks of glacial lake outburst floods (GLOFs) have high costs for the lowland cities and urban infrastructures (e.g., hydropower, water supply, roads). The Imja Lake located in the Everest region is one of the three critical lakes that need immediate attention, and its potential damage is estimated to be around 11 billion dollars. Understanding how the GLOF risks are being perceived by the locals is part of a new research grant "Science-driven, Community-based Approach to GLOF risks reduction in the Everest Region, Nepal," which takes an interdisciplinary approach to analyze the local priorities, mitigation options, and emergency preparedness criteria. This poster introduces how a socio-ecological and technical systems (SETS) framework can be used to analyze how GLOF risks and vulnerability for the mountain villages and the downstream lowland cities. It presents the preliminary results of the 2016 fieldwork, which included 150 household surveys, 24 semi-structured interviews, and three focus groups. Using the SETS framework, it analyzes the governance and the institutions crucial for the socio-ecological gradient covering the potential GLOF affected areas. The past GLOF events in the region have had devastating impacts, and therefore, the GLOF risks of the Imja Lake must be examined within a broader regional SETS context.

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***Smith, J. P., X. Li, and B. L. Turner. *Lots of potential: Urban vacant land identification from high resolution remote sensing imagery*.**

Making use of vacant land is a challenge faced by cities of all sizes. Knowing the physical characteristics and distribution of these properties is necessary for identifying future development opportunities. Past studies distinguishing open vacant land for potential urban agriculture have relied primarily on visual identification from remotely sensed imagery or the use of parcel information from cadastral data. The application of either technique alone can be problematic for accurately representing open land for a variety of reasons. This study provides the a systematic assessment of non-governmental open vacant land for the Phoenix metropolitan area—land parcels that are or can be privately owned but which contain no buildings, are unpaved, have no apparent use, and are potential candidates for urban agriculture. To create such an inventory, a new method for the identification of vacant land was developed that combines remote sensing techniques and cadastral data and trains the computer to distinguish different forms of vacant land. This method will help planners and scientists alike utilize vacant land in dealing with challenges from urban agriculture in the form of community gardens as a way to combat urban food deserts to the mitigation of the urban heat island effect by increasing green space land cover.

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***Sykes, B., P. Hutton, P, and K. J. McGraw. *City living reverses the relationship between disease and color in a desert songbird*.**

Historically, studies of condition-dependent signals in animals have been male-centric, but recent work suggests that female ornaments can also communicate individual quality (e.g., disease state, fecundity). There has been a surge of interest in how urbanization alters signaling traits, but we know little about if and how cities affect signal expression in female animals. We measured carotenoid-based plumage coloration and coccidian (*Isospora* spp.) parasite burden in desert and city populations of house finches to examine links between urbanization, health state, and attractiveness in males and females. In earlier work, we showed that male house finches are less colorful and more parasitized in the city, and we again detected that pattern in this study for males. However, though city females are also less colorful than their rural counterparts, we found that city females were less parasitized. Also, regardless of sex and unlike rural birds, more colorful birds in the city were more heavily infected with coccidia. These results show that urban environments can disrupt signal honesty in female animals and highlight the need for more studies on how cities affect disease and condition-dependent traits in both male and female animals.

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***Teal, C.N.[1], B. Polidoro[2], R. Rushford[3], and B. Ball[2]. *Testing compost use in Phoenix city parks: impacts on soil nutrients and biology*.**

Parks around the PMA (Phoenix Metropolitan Area) and many in other U.S. cities are using synthetic fertilizer in their turf management practices. Inorganic fertilizer like the ones used in parks have been shown to be hazardous to the surrounding environments and local ecosystems. Using synthetic fertilizer releases a large volume of labile forms of nitrogen immediately onto the soil as a way of introducing nutrients to the plants. The problem with nitrate (a labile form of N) is that it can easily contaminate water supplies by a process

known as nitrate leaching. The use of synthetic fertilizer combined with the irrigation methods make the PMA easily susceptible to nitrate contamination. Due to the possible negative effects of synthetic fertilizers, the City of Phoenix Parks and Recreation Department and the city composting program have collaborated to create the Phoenix Composting Project. In this project we aim to determine whether or not compost is a sufficient replacement for synthetic fertilizer as a soil amendment in the City of Phoenix park system. Since we are only in the beginning stages of testing we have not seen significant results between compost plots and control plots, but we have seen differences between each park. As our study progresses we hypothesize that replacing inorganic fertilizers with compost will improve soil health, resulting in greener grass. In addition, water absorption and infiltration in the soil will be improved, which will save money and resources. Furthermore, we expect that the microbial biomass and invertebrate populations will increase, resulting in a healthier soil ecosystem.

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Templeton, N. P.[1], E. R. Vivoni[1,2], Zhi-Hua Wang[1], and A. P. Schreiner-McGraw[2].** ***Quantifying water and energy fluxes over different urban land covers in Phoenix, Arizona**.**

Urbanization is expected to impact water and energy fluxes in particular when sharp contrasts are created with the pre-existing natural environment. Nevertheless, urban flux observations are very limited given the wide variety of land cover types present in cities. To help address this need, a mobile eddy covariance (EC) tower was deployed at three locations in the Phoenix, Arizona, metropolitan area, to sample the surface energy balance (SEB) at a parking lot, a xeric landscaping (drip irrigated trees with gravel cover) and a mesic landscaping (sprinkler irrigated turf grass). These short-term deployments were compared to a stationary EC tower located in a suburban neighborhood and spanning the entire sampling period. A comparison of the observations revealed key differences between the mobile and stationary sites tied to the urban land cover distributions within the measurement footprints. Net radiation varied substantially among the sites, due to albedo and soil temperature differences. The partitioning of available energy between sensible and latent heat fluxes was modulated strongly by the presence of outdoor water use, with the turf grass exhibiting the highest proportion of evapotranspiration. At this site, we identified a decoupling between turbulent flux partitioning and precipitation events indicating that frequent outdoor water use removes water limitations on the SEB for mesic landscaping in an arid climate. Other urban land covers with less frequent irrigation, however, exhibited sensitivity to the occurrence of precipitation events across different seasons. Therefore, quantifying the frequency and magnitude of outdoor water use is critical for understanding the spatiotemporal variability of the SEB in arid urban areas.

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***Urcuyo, J. C., and J. C. Johnson. *Urban heat island effects: how temperature influences male development and behavior in the western black widow spider*.**

The urban heat island (UHI) effect causes temperatures to be warmer in urban areas when compared to rural areas because built structures tend to capture heat throughout the day and retain it into the evening. The western black widow spider (*Latrodectus hesperus*) has become a pest in Phoenix's UHI. Here we examine the impact of the UHI on the various behaviors that male black widows exhibit. Due to the elevated temperature from the UHI, arthropod metabolism increases and we hypothesize a notable change in the lifestyle of male black widows. To simulate urban and desert summer nights, spiders were raised at 33º and 27ºC, respectively (field collected temperatures during July 2015 nights). At these temperatures, we focus on male development, mass gain, mortality, foraging voracity, and courtship activity and success. From these methods, we predict that males from the urban heat treatment experience an accelerated rate of development and decreased body mass. Similarly, we expect foraging voracity to increase, courtship activity to increase, and courtship success to decrease. Results show that the urban heat treatment, in fact, slows the development of males, while still increasing their foraging voracity. This gives us a glimpse into why black widows thrive in urban environments and how male survivorship and behaviors vary between urban and desert temperatures. By evaluating this urban heat island effect, we are able to better understand the behaviors of black widows and other urban pests and their populations.

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***Vega, M. N.[1], B. Ball[1], K. Wickings[2], L. Christenson[3], K. Berry[2], S. Peters-Collaer[3], and P. Susman[3]. *Pathways and patterns of plant litter chemistry throughout decomposition*.**

Decomposition of plant litter is a fundamental biogeochemical process, integral to ecosystem nutrient cycles. While numerous studies have yielded rich amounts of data describing how litter chemical content relates to its decomposition, most focus only on initial chemistry as an indicator of how litter will behave throughout decomposition. This limits our understanding of later stages of decay, which are important for long-term ecosystem processes and biogeochemical cycling. We explored whether diverse plant litter types maintain initial chemical differences throughout decay, remaining chemically unique, or if decomposing litter follows different chemical trajectories over the course of decomposition. Further, we investigate how these trajectories relate to litter decay rate, and we attempt to identify the local environmental drivers, including climate and decomposer communities that may influence the patterns and temporal variability in litter chemistry during decomposition. Many archived decomposition studies have been collected from long-term ecological research sites (LTER) to analyze a comprehensive set of chemistry. We conducted four analyses: carbon to nitrogen ratio using an elemental analyzer, Py-GCMS to measure compounds such as lipids and phenols, sequential acid digestion for fiber analysis, and ICP-OES for micronutrients. Our preliminary data demonstrates that litter chemistry varies throughout decomposition, not strictly following one pattern. More samples are being analyzed to understand what drives these differing fates. We will continue to collect litter samples from completed decomposition studies across the LTER network and analyze the complete set of litter chemistry parameters.

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***Wang, C., R. Upreti, Z. Wang, and J. Yang. *Impact of shade trees on urban hydroclimate for Phoenix and the continental United States*.**

The presence of built terrains modifies land surface energy and water transport with drastic land use and land cover changes, leading to adverse environment issues, a prominent example being the urban heat island effect. As an important urban mitigation strategy, trees in urban areas have shown as effective to alleviate excessive thermal stress in urban areas; the main mechanisms including the radiative shading and evapotranspirative cooling. In this study, we evaluated the impact of shade trees on urban hydroclimate via its participation in radiative exchange. A coupled Weather Research and Forecasting (WRF) and advanced urban canopy modeling framework is adopted in this study and applied to the Phoenix metropolitan as well as the continental United States. Results indicate that effect of shade trees is dependent on many factors including tree sizes, urban morphology, and geographical locations. The cooling effect of trees helps to enhance human thermal comfort level as well as to improve building cooling efficiency for most US cities during hot seasons, but can potentially lead to the heating penalty in winters, especially for cities located at high latitudes. The research findings in this study can therefore provide new insight into energy partitioning in the urban environment, and useful guidance to shade tree programs in water-energy-climate repercussions.

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***Wheeler, M. M.[1], E. R. Vivoni[2], and S. J. Hall[1]. *Residential soil water model evaluation to improve outdoor water use recommendations in an arid city*.**

Despite the development of urban programs promoting low water use landscaping, little is known about the amount of outdoor water actually applied in residential yards with varying types of landscaping. Previous work using a numerical model of soil moisture dynamics revealed that yards in Phoenix, Arizona may be irrigated far above recommendations from water conservation programs. However, as these predictions were based on a limited number of experimentally managed sites, further evaluations are needed to address the heterogeneity of residential yards present in urban areas. We compared model predictions with soil moisture observations from 11 residential yards that sample a much wider range of conditions. The model as originally parameterized was not able to reproduce the soil moisture dynamics recorded in the field. Overall, observed soil moisture responded more strongly to water input than predicted and in non-irrigated xeric yards was higher on average than predicted, which may indicate higher than expected water use in many residential yards. Additionally, soil moisture behaved very differently in flood-irrigated vs. sprinkler-irrigated lawns, which was not captured by the original model. Variability among soil, vegetation, and irrigation characteristics within the yard types used was too great to be adequately represented by a single model calibration, indicating a need for more specific classification of yards and additional calibrated model parameters to fit these classifications. This extension of the model will facilitate improved estimates of irrigation water conservation potential grounded in observations of conditions in Phoenix yards.

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Wright, M. K.[1], P. C. Chakalian[2], L.C. Kurtz[2], L. E. Watkins[1], S. L. Harlan[3], M. Georgescu[1], and D. M. Hondula[1].** ***Extreme heat and power failures; understanding household-scale risks.

Extreme heat is a climate-sensitive health hazard of concern in many cities around the world. Public health agencies and scientists working with CAP LTER have produced a considerable volume of research in recent years concerning heat-related health impacts in central Arizona ranging from mortality to discomfort. Through this research, we have learned that heat-health impacts are closely linked with regional ecology. Heat vulnerability is higher in many lower-income neighborhoods where vegetation coverage is lower and land surface temperatures are higher. Future health impacts from long-term stressors like global and urban-scale warming along with shocks like energy system disruptions are expected to hit resource-constrained populations the hardest.

Our poster introduces a new project that builds from past CAP research in an effort to improve regional hazard resilience. Funded by an NSF Hazards-SEES grant, an interdisciplinary team of researchers at ASU, Georgia Tech, and the University of Michigan are examining what would happen in Phoenix, Atlanta, and Detroit if the three cities suffered widespread, multi-day power failures during a heat wave. We are striving to uncover the specific social and environmental mechanisms that determine urban vulnerability when independent or coupled heat and power failure events occur. Our poster shares preliminary findings from summer 2016 data collection in Phoenix, which involved household surveys (n=149), semi-structured vignette interviews (n=47), and indoor, outdoor, and personal temperature sensors (n=41). Large contrasts in household experiences and coping strategies with heat are evident in these data, particularly with respect to indoor temperature variance and anticipated emergency response strategies.

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