15th Annual

CAP LTER All Scientists Meeting and Poster Symposium

Friday, January 11, 2013

SkySong

ASU Global Institute of Sustainability

LTER

NSF

CAP LTER Fifteenth Annual Poster Symposium and All Scientists Meeting January 11, 2013 Skysong, Scottsdale, Arizona

Looking Ahead from Fifteen Years of Urban Socio-Ecological Research to Address the Challenges of Urban Sustainability

8:00 am Registration, coffee, and tea

8:30 am **Welcome** - Nancy Grimm, Lead PI and Director of CAP LTER; Professor, School of Life Sciences, College of Liberal Arts and Sciences

8:45 am **Transitions in Urban Environmental Systems - Lessons from New York City and Hurricane Sandy**.
William Solecki, Director, CUNY Institute for Sustainable Cities (CISC), and Professor, Department of Geography, Hunter College, CUNY
Co-sponsored by the Global Institute of Sustainability and the Decision Center for a Desert City

9:45 am **Human Influences on Species Interactions in Urban Communities: Putting CAP LTER in Context**.
Paige Warren, Associate Professor, Environmental Conservation, University of Massachusetts-Amherst

10:00 am **Creating the Park Cool Island in an Inter-City Neighborhood: Heat Mitigation Strategy for Phoenix, Arizona**
Juan Declet-Barreto, Ph.D. Candidate, School of Human Evolution and Social Change

10:15 am **Poster Session #1**

11:30 am **Lunch (for participants who have RSVPed)** and continued poster viewing

11:45 am **Lunch and IPA Working Group Breakout Sessions** –
Biogeochemical Patterns, Processes, and Human Outcomes: Room-Discovery (3rd floor)
Climate, Ecosystems, and People: Room- Convergence (main)
Human Decisions and Biodiversity: Room- Global (2nd floor)
Land Use, Land Cover, and Land Architecture: Room-Enterprise (posters)
Water Dynamics in a Desert City: Room- Convergence (main)

1:30 pm **IPA/Working Group Breakout Session Reports**

2:30 pm **CAP LTER Science**
Speaker to be announced

2:45 pm **A Knowledge-to-Action Research Story from a Hard-Working Urban Wetland Ecosystem**
Dan Childers, Professor, School of Sustainability

3:00 pm **Service Plaque presentation**

3:05 pm **Poster Session #2**

4:30 pm **Conclusions – Nancy Grimm**

5:00 pm **Adjourn for CAPpy Hour at Papago Brewing**

2013 CAP LTER Symposium

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

Poster Session #1	Poster Session #2
Ackley (21)	Adams (50)
Ball (31)	Beute (24)
Bleasdale (27)	Camba (30)
Christman (9)	Cook (14)
Chuang (23)	Declet-Barreto (20)
Davies (33)	Ferrell (40)
Deitrick (7)	Gburek (32)
Fishman (41)	Hale (52)
Gentile (49)	Hall (34)
Halpin (35)	Ibes (42)
Hartnett (11)	Kane (8)
Hartnett (13)	Kaplan (44)
Hernandez (51)	Lane (36)
Holland (15)	Learned (46)
Huber (3)	Loza Morales (54)
Johnson (37)	Marusenko (10)
Larson (43)	McAlister (6)
Li (45)	Mousel (4)
Lorenz (1)	Nzengya (26)
Middel (25)	Palta (16)
Ouyang (53)	Palta (18)
Ramos (55)	Quay (56)
Rushforth(57)	Rice (58)
Sanchez (59)	Rosales Chavez (12)
Shorts (17)	Sampson (60)
Tarrant (29)	Song (22)
Trubl (39)	Stromberg (38)
Warren (47)	Tuccillo (48)
Weller (19)	Vins (28)
Wyant (5)	Weaver (2)

Speaker Bio

Dr. William Solecki

Dr. William Solecki is Director, CUNY Institute for Sustainable Cities (CISC), and professor in the Department of Geography at Hunter College – CUNY. His research focuses on urban environmental change and transition, and climate change and cities. He is currently serving as a lead author for the IPCC AR5, WGII Urban Areas chapter, as convening lead author for U.S. National Climate Assessment Urban, Infrastructure, and Vulnerability chapter, as co-Chair of the New York Panel on Climate Change (NPCC), and as a member of the scientific steering committee of IHDP, Urbanization and Global Environmental Change (UGEC) Core Project. He is a co-founder of the Urban Climate Change Research Network (UCCRN) and co-editor of the recent *Climate Change and Cities Assessment (ARC3) Report* published by Cambridge University Press. He is co-editor of the journal *Current Opinion in Environmental Sustainability, and editor of the Journal of Extreme Events.* He also has served as the leader or co-leader of several climate impacts studies in the greater New York and New Jersey region. He holds in degrees in Geography from Columbia University (B.A.) and Rutgers University (M.A., Ph.D).

List of Posters

***Indicates student poster.**

BIOGEOCHEMICAL PATTERNS, PROCESSES, AND HUMAN OUTCOMES

*****Christman, Max, and Becky Ball. ***The Role of* Ambrosia dumosa *Litter Degradation in N Fertilization Cycles in Urban Versus Rural Environments*.**

*****Cook, Elizabeth M., Pamela Padgett, and Sharon J. Hall. ***Effects of Co-occurring Urban Atmospheric Compounds on Desert Herbaceous Plants.***

Hartnett, Hilairy, Jessica Coe, Zachery Smith, Margaret Bowman, Marissa Raleigh, Andrew Chesley, and Gordana Pavlovic. ***2D Fluorescence Analysis of Dissolved Organic Carbon in Tempe Town Lake.***

Hartnett, Hilairy, and G. Alexander Hamilton. ***Photo-oxidation and Historical Land Use Change Observations of Soot Black Carbon: A Comparison of Degradation Rates.***

*****Holland, Emma, Lindsey Pollard, and Nancy B. Grimm. ***An Analysis of Biomass Growth Rates Over Time in a Desert Riparian System.***

*****Huber, David P., Kathleen A. Lohse, and Sharon J. Hall. ***Climate Controls on the Fate of Anthropogenic Nitrogen Additions in Desert Ecosystems.***

*****Marusenko, Yevgeniy, Ferran Garcia-Pichel, and Sharon J. Hall**. *Nitrogen Fertilization Creates New Niches for Amonia-Oxidizing Microbial Communities in Aridland Soil.***

Palta, Monica M., Peter Groffman, and Stuart Findlay. ***Use of Nitrogen Budgets and N_2 Flux Measurements to Estimate the Role of Denitrification in Brownfield Stormwater Wetlands.***

Palta, Monica M., and Hilairy E. Hartnett. ***Assessment of Temporal Patterns in Dissolved Organic Carbon in Tempe Town Lake.***

*****Shorts, Danielle, Rebecca L. Hale, Stevan Earl, and Nancy B. Grimm. ***Hydrological and Geochemical Effects on Denitrification Potential in an Arid Urban Wash.***

*****Weller, Nicholas, Daniel L. Childers, and Laura Turnbull. ***Impact of Plant Community Changes on Nutrient Retention within an Aridland Constructed Wastewater Treatment Wetland.***

*Wyant, Karl A., Yevgeniy M. Marusenko, Sharon J. Hall, and John L. Sabo. ***Dynamics of Urban Biogeochemical Cycling Coupled with the Interactions Between Soil Microbial Communities, the Belowground Food Web, and Land Use Type in an Arid Ecosystem.***

CLIMATE, ECOSYSTEMS, AND PEOPLE

*Ackley, Jeffrey, Jianguo Wu, Dale DeNardo, Michael Angilletta, Soe Myint, and Brian Sullivan. ***Heat Islands, Landscaping, and the Thermal Ecology of Urban Lizards.***

*Chuang, Wen-Ching, and Patricia Gober. ***Heat Impact on Human Health in Warmer Cities: Spatial and Temporal Dimensions.***

*Declet-Barreto, Juan, Sharon Harlan, Diana Pettiti, and Benjamin Ruddell. ***Heat Vulnerability in Phoenix, Arizona: Health Outcomes, Sensitivity, Exposure, and Coping Capacity at the Neighborhood Scale.***

*Lorenz, Danielle, Matei Georgescu, and Anthony Brazel. ***Assessing Climate Impacts of Projected Continental U.S. Urban Expansion.***

*McAlister, Alyssa, Amber Wutich, Alexandra Brewis, Jonathan Maupin, and Dan Hruschka. ***Global Convergences and Divergences in Ethnotheories of Climate Change and Disease.***

Middel, Ariane, Kathrin Hab, Anthony J. Brazel, Chris Martin, and Subhrajit Guhathakurta. ***Impact of Urban Form and Design on Mid-Afternoon Microclimate in Phoenix Neighborhoods.***

*Song, Jiyun, Jiachuan Yang, and Zhihua Wang. ***Modeling CAP LTER Flux Tower Measurements Using an Advanced Urban Canopy Model.***

EDUCATION, OUTREACH AND RESEARCH SUPPORT

Bernier, Andrew, Jon Hutman, Michael Twilling, and Their Students. ***Ecology Explorers: K-12 Student Contributions to the CAP LTER Project.***

Beute, Stacie. ***Getting to Citizen Science: An Investigation of the Landscape, Typologies, and Design Frameworks of Public Participation in Scientific Research.***

*Bleasdale, Thomas, Katelyn Parady, Juan Declet-Barreto, Darren Ruddell, Sharon L. Harlan, and Anthony Brazel. ***A Web-Based Interactive Timeline of Social-Environmental Change in Central South Phoenix, 1860-2012.***

*Deitrick, Stephanie. ***Implicit Visualization as Usable Science: Visualizing Climate Uncertainty for Decision Support.***

*Nzengya, Daniel, and Rimjhim Aggarwal. ***The Impact of School-Based Participatory Water Testing Program on Knowledge and Behavior Related to Safe Water and Hygiene in Kenya.***

Tarrant, Philip, David Julian, and Ryan Raub. ***The Virtual Notebook: A "TurboTax®" Approach to Improving Research Metadata.***

*Vins, Holly, Colin Kunzweiler, Christopher M. Roberts, Melissa Beresford, Amber Wutich, and Alexandra Brewis. ***Gender Differences in Perceptions of Water in Arizona: Insights from the Science of Water Project.***

HUMAN DECISIONS AND BIODIVERSITY

Ball, Becky, and Ross A. Virginia. ***Moss Nutrient Plasticity in Desert Ecosystems: A Hot Cold Desert Comparison.***

*Camba, Matthew O., Dana Nakase, Colleen Strawhacker, Jennifer Learned, and Sharon J. Hall. ***Landscape Legacies and Succulent Distribution.***

*Davies, Scott, and Pierre Deviche. ***Advancing Reproductive Phenology of an Urban Bird is not Mirrored in the Underlying Reproductive Physiology.***

*Gburek, Theresa M., Joanna Jewell, and J. Chad Johnson. ***Ecology and Color Morphology of Urban-Dwelling Black Widow Populations.***

*Halpin, Rebecca, and J. Chad Johnson. ***Behavioral Syndrome Versus Adaptive Plasticity: Documenting the Foraging, Mating, and Anti-Predator Behavior or Urban and Desert Black Widows.***

Hall, Sharon J., Scott Yabiku, Abigail York, Dirgha Ghimire, Li An, Jennifer Glick, and Binoj Shrestha. ***Feedbacks Between Human Community Dynamics and Socio-Ecological Vulnerability in a Biodiversity Hotspot.***

Johnson, J. Chad, Rebecca Halpin, Susannah Sandrin, Chad Bauman, Alan Wirkus Camacho, AJ Diedtrich, Sumaita Mulk, Anuj Pate, Nick Planidin, Eric Slosky, Javier Urcuyo, and Kimberly A. Landsdowne. ***Cannabalism Versus Social Tolerance in an Urban Pest: What Makes Black Widows Want to Kill Each Other?***

*Lane, Samual, Pierrie Deviche, and Scott Davies. ***City Sounds: The Effects of Urbanization on Bird Song.***

*Mousel, Melanie, Mathieu Giraudeau, and Kevin McGraw. ***Parasites in the City.***

Stromberg, Julie, Heather Bateman, Jennifer Foutz-Sweat, Dustin Wolkis, Brenton Scott, Amanda Suchy, Elizabeth Makings, and Nicole Wilson. ***Just Add Water: Benefits of Passive Restoration in an Urban Floodplain.***

*Trubl, Patricia, and J. Chad Johnson. ***Population Ecology and Stoichiometry of the Western Black Widow Spider: From Solitary Desert Predator to Urban Pest.***

*Weaver, Melissa, Kevin J. McGraw, and Melanie Mousel. ***Avian Anthrophobia? Stress Response of House Finches (*Haemorhous mexicanus*) Across an Urban Gradient in the Presence of Humans.***

LAND USE, LAND COVER, AND ECOSYSTEM SERVICES

*Ferrell, Janet, and Mikhail Chester. ***Life Cycle Assessment of Ecosystem Services for Phoenix's Building Stock.***

*Fishman, Jacob, and V. Kerry Smith. ***Are Households' Attitudes Toward Ecosystem Services Consistent with Estimates of Economic Tradeoffs to Enhance These Services?***

*Ibes, Dorothy C. ***One Park, Two Park, Green Park, Brown Park: A Classification of Arid Urban Parks and Their Ecosystem Services.***

*Kane, Kevin, Joseph Tuccillo, Abigail M. York, Lauren Gentile, and Yun Ouyang. ***Land Use Change and the Urban Landscape: A Spatio-Temporal View of Historical Growth in Phoenix, Arizona.***

*Kaplan, Shai, Christopher Galletti, Winston Chow, and Soe Myint. ***Modeling Broadband Albedo with High Resolution Imagery.***

Larson, Kelli L., Jaleila Brumand, Elizabeth Cook, and Sharon Hall. ***The Human Ecology of Residential Landscape Management: Complex Causes, Effects, and Tradeoffs in the Sonoran Desert of Phoenix, AZ.***

Learned, Jennifer, Dana Nakase, Enrique Vivoni, and Sharon J. Hall. ***Experimentally Validated Mathematical Modeling Reveals the Influence of Surface Rock Cover on Soil Water Availability in a Semi-arid Ecosystem.***

Li, Xiaoxiao, and Yujia Zhang. ***Object-Oriented Land-Cover Classification Using Aerial Photography in Semi-arid Area.***

Tuccillo, Joseph, and Christian Van Gijlswijk. ***Peopling Phoenix's Past: Examining Spatial Demography in Early Central Phoenix Using Historical United States Census Records.***

Warren, Paige, Craig Nicolson, Michael Stohbach, Robert Ryan, Colin Polsky, Chingwen Chen, Rachel Danford, and Victoria Wolff. ***Quantifying Effects of Urban Growth and Urban Greening – Preliminary Findings from a Stakeholder-Driven Scenario Analysis.***

WATER DYNAMICS IN A DESERT CITY

*Adams, Elizabeth A., and Benjamin L. Ruddell. ***Embedded Resource Accounting Analysis of Water Used for Agriculture and Energy Production in the Western United States.***

*Gentile, Lauren, Joseph Tucillo, Katelyn K. Parady, and Bob Bolin. ***Desertification in the Central City: A Political Ecology of the Environmental Change in Phoenix, AZ.***

*Hale, Rebecca L., Danielle Shorts, Sarah Moratto, Laura Turnbull, Stevan Earl, and Nancy Grimm. ***Stormwater Infrastructure Effects on Urban Nitrogen Budgets.***

*Hernandez, Amada, Monica M. Palta, and Nancy B. Grimm. **Escherichia coli *(E. coli)* Pulsing and Attenuation in "Accidental" Urban Wetlands.***

*Loza Morales, Daniel E., Daniel L. Childers, Ariah Evans, Aunese Evans, Christopher A. Sanchez, and Nicholas Weller. ***Macrophyte Decomposition Rates in the Tres Rios Constructed Treatment Wetland: Preliminary Results.***

*Ouyang, Yun, Elizabeth Wentz, Benjamin Ruddell, and Sharon Harlan. ***A Multi-scale Analysis of Single Family Residential Water Consumption in the Phoenix Metropolitan Area.***

Quay, Ray, Adam Miller, and Pam Nagel. ***Exploring the Uncertainty within Residential Water Demand.***

*Ramos, Jorge, Eric J. Chapman, Nicholas A. Weller, and Daniel L. Childers. ***Greenhouse Gas Emissions from a Constructed Wetland System in Phoenix, AZ.***

*Rice, Jacelyn, and Paul Westerhoff. ***How Much Wastewater is in Central Arizona Project Source Waters?***

*Rosales Chavez, Jose, Amber Wutich, Alexandra Brewis, Abigail M. York, and Rhian Stotts. ***Rules, Norms, and Injustice: A Cross-Cultural Study of Perceptions of Justice in Water Institutions.***

*Rushforth, Richard R., Elizabeth A. Adams, and Benjamin L. Ruddell. ***Embedded Resource Accounting: Generalized Ecological, Water and Carbon Footprint Methodologies.***

Sampson, David A., and Ray Quay. ***High Probability of Near-Term Shortages for the Central Arizona Project: Surface Water Reductions and the Assured Water Supply Program (Simulations Using WaterSim 5).***

*Sanchez, Christopher A., Daniel L. Childers, Laura J. Turnbull, and Nicholas A. Weller. ***The Contribution of Evapotransportation to the Annual Water Budget of an Aridland Urban Wastewater Treatment Wetland.***

Abstracts

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

Ackley, J.[1], J. Wu[1], D. DeNardo[1], M. Angilletta[1], S. Myint[2], and B. Sullivan[3]. *Heat Islands, Landscaping, and the Thermal Ecology of Urban Lizards.

Climate change is predicted to drive 40% of lizard populations extinct by 2080. This assertion that large-scale shifts in climate are relevant to small ectotherms which experience temperature on a near instantaneous sub-meter scale assumes that species will not adapt by dispersal or shifting their activity patterns. However, local adaptations may already be observable in Phoenix, AZ, where a heterogeneous urban heat island (UHI) averages +3°C and can locally exceed +10°C at night. Interestingly, Phoenix also has an urban oasis effect, where heavily irrigated mesic landscaping can be cooler than the native desert during the day. This potential UHI mitigation strategy was evaluated from the perspective of lizards using the CAP LTER North Desert Village experiment.

Thermally realistic lizard models with temperature data loggers were placed in a bare lot (control), and several treatments that represent the dominant landscaping styles in Phoenix. In midsummer, potential lizard activity time was found to be almost non-existent in native and xeric plots, while the mesic plot allowed for continual activity during even the hottest days. Interestingly, underground temperatures in the mesic plot were actually too cold for proper egg development. A preliminary inspection of microhabitat characteristics revealed that shade explained the vast majority of variation in model temperatures. Distance to vegetation and relative humidity did not appear to influence model temperature, suggesting that artificial shade structures may also extend potential lizard activity time in summer.

[1]School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501; [2]School of Geographical Sciences and Urban Planning, Arizona State University, PO Box 875302, Tempe, AZ 85287-5302; and [3]New College of Interdisciplinary Arts and Sciences, Arizona State University at the West campus, PO Box 37100, Phoenix, AZ 85069-7100

Adams, E. A.[1], and B. L. Ruddell[2]. *Embedded Resource Accounting Analysis of Water Used for Agriculture and Energy Production in the Western United States.

Climate change is expected to cause increasing temperatures and evaporation, decreased rainfall, and more intense droughts in the southwestern U.S. As population in urban areas grows, resource demands increase and become more spatially concentrated – especially demands for electrical energy, which, due to transmission limitations, must currently be produced within the region. Energy production accounts for the largest percentage of gross water withdrawals in the U.S., and irrigated agriculture is the largest net consumer of water in the U.S. Water resources lay at the center of this nexus as an important and climate-sensitive constraint on both agricultural and electrical energy production.

Re-allocation of water supplies will be necessary to adapt reduced supplies to meet changing demands. Therefore, novel approaches to the analysis of the interconnections between water, energy, and agriculture are needed for the purpose of informing policy for the 21st century. This study addresses the indirect, or virtual, use of water resources embedded in agriculture and energy in the water-scarce western U.S. By combining virtual water concepts with economic trade data, we are able to reveal trends in the trade of virtual water embedded in agriculture and electricity. Using an Embedded Resource Accounting

(ERA) analysis, our results document and explain the implicit water trade network embedded within the western U.S. electrical energy and agricultural markets.

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Ball, B., and R. A. Virginia. ***Moss Nutrient Plasticity in Desert Ecosystems: A Hot-Cold Desert Comparison*****.**

Desert biology live close to the physical limitations for life, constrained by low availability of water and nutrients. In both hot and cold deserts, moss may play an important role connecting soil and stream nutrient cycling, where stream nutrients may be taken up by moss growing at the terrestrial-aquatic interface, which may be windblown into the surrounding soil to become an organic matter source in the soil. Nitrogen deposition to aridlands is increasing due to anthropogenic sources, altering nutrient availability to influence soil biology and biogeochemical processes. Despite its importance, very little is known about moss' role in biogeochemical cycles, such as the plasticity of their nutrient uptake and stoichiometry, and therefore it is unclear how nutrient pulses will affect their functional significance as an integrator of nutrient cycling in deserts. We sampled moss in both a polar desert (MCM LTER) and a hot desert (CAP LTER), to determine whether the nutrient content of the moss varies in relation to environmental gradients of nutrient content. A survey of moss and soil stoichiometry from locations varying in soil nutrient status suggests that moss nitrogen and phosphorus content are positively correlated with nutrient availability in the soil and/or water. Polar desert (MCM) moss C:N:P loosely varies according to soil (and water) nutrient availability, but hot desert (CAP) mosses clearly take advantage of excess soil N availability However, a comparison of moss stoichiometry to the potential nutrient sources individually revealed that the sources most strongly correlated differed for N versus P.

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Bernier, A.[1], J. Hutman[2], M. Twilling[3], and Their Students. ***Ecology Explorers: K-12 Student Contributions to the CAP LTER Project.***

Students from across the Phoenix metropolitan area have been collecting data in their schoolyards using Ecology Explorers protocols. Select posters will be presented by middle and high school students.

[1]CREST Paradise Valley High School, 3950 E. Bell Rd, Phoenix, AZ 85069; [2]Centennial Middle School, 13808 E. Bell Rd, Phoenix, AZ 85044; and [3]Gary K. Herberger Young Scholars Academy, PO Box 37100, Phoenix, AZ 85069

Beute, S. ***Getting to Citizen Science: An Investigation of the Landscape, Typologies, and Design Frameworks of Public Participation in Scientific Research.***

Public participation in scientific research (PPSR), commonly called citizen science, has the potential to gather scientific data at large spatial and temporal scale[1], advance scientific literacy in participants[2], facilitate communication between scientists and stakeholders, and grow the capacity for science-informed policy and management[3]. In as much, use of PPSR is

on the rise4. Yet, nomenclature, best practices, typologies, and those program design features predictive of success in PPSR are still emerging and often disagree. Researchers suggest that ambiguity in the field and underuse of program design and operational frameworks is such that many projects fail to capitalize on the opportunities presented by PPSR[4,5]. Through an examination of PPSR case studies and literature, I explored the landscape of PPSR, sought clarity in terms, reviewed published PPSR typologies for congruence, and worked to aggregate those elements and practices requisite to successful program design and operation. I suggest that there are areas where the field is stabilizing, and areas where it remains unsettled. Agreed upon nomenclature exists, but is scarce. This is consistent with disagreement among researchers in how to parse and name types of PPSR. Across published program design frameworks, I found principles in common are overwhelmingly those standard to scientific research while major differences exist in elements specific to public participation. No single framework is complete in providing clear mechanisms for realizing the full potential of PPSR. Through aggregating and editing frameworks, I produced a rough version of the kind of tool I believe will be necessary to build robust PPSR programs moving forward.

[1]Dickinson, J., B. Zuckerberg, and D. Bonter. 2010. Citizen science as an ecological research tool: Challenges and benefits. *Annu. Rev. Ecol. Evol. Syst*. 41: 149-172.
[2]Bonney, R., H. Ballard, R. Jordan, E. McCallie, T. Phillips, J. Shirk, and C. C. Wilderman. 2009. *Public Participation in Scientific Research: Defining the Field and Assessing its Potential for Informal Science Education*. A CAISE Inquiry Group Report. Washington, D.C.: Center for Advancement of Informal Science Education.
[3]Vaughn, H. 2007. Citizen science as a catalyst in bridging the gap between science and decision-makers. *In* C. McEver, R. Bonney, J. Dickinson, S. Kelling, K. Rosenberg, and J. Shirk, eds., *Proceedings of the Citizen Science Toolkit Conference,* Cornell Laboratory of Ornithology, Ithaca, New York.
[4]Conrad, C., and T. Daoust. 2008. Community-based monitoring frameworks: Increasing the effectiveness of environmental stewardship. *Environmental Management* 41:358-366
[5]Lepczyk, C., O. Boyle, T. Vargo, P. Gould, R. Jordan, L. Liebenberg, S. Masi, W. Mueller, M. Prysby, and H. Vaughan. 2009. The increasing acceptance, role, and importance of citizen science in ecology. *Bull. Ecol. Soc. Am.* 90(3):308-317.
Desert Botanical Garden, 1201 N. Galvin Pkwy, Phoenix, AZ 85008

***Bleasdale, T.[1], K. Parady[1], J. Declet-Barreto[1], D. Ruddell[2], S. L. Harlan[1], and A. Brazel[3]. *A Web-Based Interactive Timeline of Social-Environmental Change in Central South Phoenix: 1860-2012*.**

This project is a web-based interactive timeline that documents social and environmental changes in south Phoenix from its agrarian origins in the late 19th century through 20th century industrialization and 21st century development. Residents of these communities today are vigorously striving to overcome environmental injustices and pursuing a better quality of life in their neighborhoods. The timeline is an extension of a historical exhibit displayed in the George Washington Carver Museum and Cultural Center in 2012. Data for the timeline have been synthesized from a multidisciplinary collaboration of social and physical scientists. Historical events affecting this community are categorized into broad themes: agriculture, climate change, economy, industry, land cover change and water. The timeline allows for exploration of a particular event, category of events or examination across categories to show the dynamic nature of multiple interacting changes that have contributed to increasing local environmental risks for residents. Events within each category are linked to further readings, photos and videos. This format creates a rich story of how a community can become vulnerable over time and illustrates how a modern urban community

experiences heightened risk in the form of environmental toxins, extreme weather, the heat island, access to nutrition and discriminatory labor and economic practices. The timeline will be an analytic tool used by researchers to examine the historical events and processes that create a modern urban riskscape and to increase public awareness of events that create vulnerable neighborhoods in a U.S. city.

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***Camba, M. O.[1], D. Nakase[1], C. Strawhacker[2], J. Learned[1], and S. J. Hall[1]. *Landscape Legacies and Succulent Distribution*.**

Plant abundance and distribution are determined by both biotic factors such as competition and facilitation, as well as abiotic factors such as climate and geomorphic properties. Succulent species have been shown to be associated with surface rocks in drylands, as these soil features may provide favorable microclimates for colonizing plants. However, the strength of the rock-succulent association across heterogeneous landscapes is unclear. Much of the land area in the arid and semi-arid US Southwest has been modified by prehistoric human activity, including movement of surface rocks in former agricultural fields for the purpose of water management. In this research, we ask, did rock movement by ancient farmers leave lasting effects on modern succulent distribution? We investigated the relationship between succulent distribution and geomorphic properties, including surface rock cover, soil texture and hill slope position, in an archaeologically rich landscape within the Agua Fria National Monument, AZ. We found that 1) Succulents are distributed more frequently at the tops of hills and are not directly affected by percent rock cover or soil texture, 2) Succulents are strongly associated with rocks at the tops of hills but weakly associated with rocks at other topographic positions, and 3) succulent abundance is strongly associated with rock cover within archaeological sites, including terraced agricultural fields. These findings suggest that human movement of surface rocks can affect the abundance and distribution of plant species, and that facilitation and indirect effects by rocks may be important for succulent growth and colonization in certain landscape patches, such as the tops of hills.

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Christman, M.[1] and B. Ball[2]. *The Role of* Ambrosia dumosa *Litter Degradation in N Fertilization Cycles in Urban Versus Rural Environments.

Arid ecosystems cover a third of Earth's terrestrial surface and are among the fastest urbanizing areas globally. Similar to other areas of the world, nitrogen (N) deposition to aridlands is increasing due to anthropogenic sources. Unlike research in wet ecosystems, however, studies on the ecological consequences of N saturation in water-limited ecosystems are surprisingly few. Previous work suggests that processes that promote N retention in other ecosystems are qualitatively different or absent in deserts, and that multiple N-loss pathways are prevalent. In the proposed research, I will conduct litter decomposition experiments to explore the possible fates of added N temporarily stored in herbaceous vegetation. Over 40 weeks of decomposition, nitrogen, carbon, phosphorous, lignin, and microbial biomass will be observed to represent both the chemical and biological dynamics during litter degradation. Three (3) g of *Ambrosia dumosa* litter was placed into 128 separate pouches. *A. dumosa* litter was collected from the Phoenix city core (subject to N

deposition) or sites downwind, from either plots that had been artificially treated with N and phosphorous or from control plots. Litter from each plot was then placed into either UV transparent or UV opaque litterbags and placed back into the core or downwind sites. Samples will be collected at intervals of 10 weeks, 20 weeks, 30 weeks, and 40 weeks over the next year and tested to determine how N and P release during biological and photodegradation differs between the urban and rural ecosystem.

[1]School of Sustainability, Arizona State University, PO Box 875502, Tempe, AZ 85287-5502: and [2]Division of Mathematics and Natural Sciences-West, 4701 W. Thunderbird Road, Glendale, AZ 85069

Chuang, W-C.[1], and P. Gober[2,3]. *Heat Impact on Human Health in Warmer Cities: Spatial and Temporal Dimensions.

Excessive heat is associated with increased morbidity and mortality. However, the risks are disproportionately distributed across any given urban area. This research uses both temporal and spatial approaches to better understand patterns of heat-related illness (measured by heat-related emergency dispatches) in Phoenix, Arizona, and Chicago, Illinois, from 2003 to 2006.

From temporal perspective, we used the Negative Binomial Regression model to examine the relationship between daily maximum temperature, heat index (a combination of temperature and relative humidity), and heat-related emergency calls (heat-stress calls) in the two cities. Using the model results, we also estimated the volume of calls under different climate change scenarios. In the second part of the analysis, we used a spatial statistical approach (Getis-Ord Gi) to identify hot spots (clusters) of heat-stress calls, and explore socioeconomic and biophysical characteristics of these hot spots. We found that 1) heat-stress calls increase sharply when the temperature exceeds 35°C in Chicago and 45°C in Phoenix; 2) Chicago residents are far more vulnerable to climate-change impacts than Phoenix residents; 3) prolonged exposure to heat has as much impact on health as extreme heat events do; 4) heat-stress calls were concentrated within neighborhoods with low socioeconomic status.

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Cook, E. M.[1], P. Padgett[2], and S. J. Hall[1]. *Effects of Co-occurring Urban Atmospheric Compounds on Desert Herbaceous Plants.

Plants and ecosystems are rarely exposed to a single pollutant, yet research on the effects of co-occurring atmospheric compounds is limited. Carbon dioxide (CO_2), ozone (O_3), and nitric acid (HNO_3) are elevated in and around cities, acting as both stressors and resources for ecosystems, but their combined impacts at realistic concentrations are unknown. Using the Central Arizona Phoenix (CAP) LTER site as a model system, we examine the net effect of elevated, but realistic concentrations of O_3 and HNO_3 on the growth and physiological responses of Sonoran Desert winter herbaceous plants. We expected that elevated concentrations of these two gases would decrease plant production, growth rate and physiological functioning. With unlimited water, aboveground biomass, growth rate and physiological parameters of non-native *Schismus arabicu*s did not significantly differ among control, O_3 or HNO_3 treatments. The native species *Pectocarya recurvata* and *Plantago ovata* appeared to be more sensitive to ozone stress, as responses were more variable among treatments (but not statistically distinct). As expected, all species responded positively to water additions with lower mortality rates and greater aboveground

biomass. Next, we plan to conduct a multi-factor dose-response experiment, exposing desert plants to combinations of elevated CO_2, O_3 and N. This research will provide empirical evidence for a multi-factor critical load that will help managers preserve native ecosystems within airsheds that are affected by co-occurring pollutants.

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Davies, S., and P. Deviche.** ***Advancing Reproductive Phenology of an Urban Bird is not Mirrored in the Underlying Reproductive Physiology**.**

For seasonally breeding animals, the decision of when to begin breeding each year has considerable effects on fitness. Birds cycle between periods of breeding activity and inactivity, which is associated with large changes in the physiology and morphology of the reproductive system. These changes require time, so birds begin to develop their reproductive system well before environmental conditions are optimal for breeding. To do this, they use environmental cues that predict conditions favorable for reproduction. Environmental conditions in urban areas of Phoenix differ from those of outlying desert areas in many respects. We hypothesized that environmental differences are associated with differences in the timing of development of reproductive morphology and physiology between urban and desert birds. To test this hypothesis, we compared the development of gonads and cloacal protuberances (a secondary sexual characteristic in male birds) between urban and desert adult male Abert's Towhees, *Melozone aberti*. To investigate the mechanism controlling reproductive development, we also measured plasma concentrations of the key reproductive hormone testosterone, which is thought to promote development of the cloacal protuberance and expression of reproductive behavior. Compared to desert conspecifics, development of reproductive morphology was advanced in urban towhees. The vernal increase in testosterone, however, was similar in urban and desert towhees. The reason for the discrepancy between development of reproductive morphology and physiology is unclear. It may reflect the lability of plasma hormone levels over short periods and/or it may suggest that physiological processes other than or in addition to reproductive hormones transduce environmental information to reproductive development.

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Declet-Barreto, J.[1], S. Harlan[1], D. Pettiti[2], and B. Ruddell[3].** ***Heat Vulnerability in Phoenix, Arizona: Health Outcomes, Sensitivity, Exposure, and Coping Capacity at the Neighborhood Scale.

Vulnerability to heat-related hazards is on the rise in cities. Heat hazards appear at the intersection of seasonally hot climates and city-specific urban heat islands, and are exacerbated by localized climate change effects. Urban heat waves linked to global and regional climate change increased in frequency and intensity over the 20th century as high temperatures exceed normal ranges of temperature variability. Vulnerability to the effects of climate change occurs within a socio-spatially differentiated spectrum of exposure, sensitivity, and adaptive (or coping) capacity that can mitigate or exacerbate the impacts of environmental hazards like extreme heat. This paper is focused on evaluating the socio-spatial distribution of sensitivity, exposure, and coping capacity that shape present heat-related vulnerability in urban neighborhoods in metro Phoenix, Arizona. To do this, we first construct and map a predictive Heat Vulnerability Index (HVI) from socio-economic and biophysical environment variables identified in the climate change vulnerability and public

health literature as influencing sensitivity to heat-related hazards. Second, we examine the relationship between exposure and health outcomes by estimating rates of heat-related hospitalizations as a function of maximum daily air temperature. Third, we compare the hospitalizations/exposure relationship in neighborhoods according to HVI scores. Finally, we describe household coping capacity by focusing on neighborhoods with different HVI profiles. Preliminary results suggest that socio-economic status, social isolation, and lack of vegetation are predictors of sensitivity in neighborhoods, and that neighborhoods with higher predicted vulnerability have steeper hospitalization/exposure curves.

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Deitrick, S.** ***Implicit Visualization as Usable Science: Visualizing Climate Uncertainty for Decision Support.

The integration of environmental science and policy offers the potential to support more informed decisions, however, scientific results are often not provided in a manner usable to decision makers. When faced with highly uncertain conditions, such as climate change, communicating scientific information in a usable manner becomes even more important. This research presents methods for representing uncertainty for decision support with the goal of making uncertain science more usable for decision makers. This research evaluated two questions. First, do implicit representations of uncertainty influence the process of evaluating courses of action and potential outcomes related to water planning? And second, do implicit representations communicate uncertainty in a manner usable by decision makers? Using results from a hypothetical city, representations of uncertainty that visualize the relationship between projected outcomes of policy decisions and uncertainty (represented as the impact of climate change on water supply) were developed. These visualizations were evaluated through a human subject test where decision makers use the uncertainty representations to identify the most robust water policy. Participants were drawn from the water planning community, professional planners, as well as DCDC community partners. The results of this research suggest that individuals used the uncertainty representations to identify the most robust policy choices. Additionally, participants were able to identify that climate uncertainty was implicitly visualized in the results, even when not explicitly shown.

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Ferrell, J., and M. Chester.** ***Life Cycle Assessment of Ecosystem Services for Phoenix's Building Stock.

Despite the importance of ecosystem services for sustaining anthropogenic activity, they are generally poorly accounted for in most urban sustainability assessments. Including ecosystem services in life cycle assessment (LCA) is an important step to provide rigorous environmental impact accounting to decision makers. This study developed a framework for including ecosystem service impact categories in building construction LCA, and tested these methods in an assessment of Phoenix, Arizona. This inventory identifies the origins of materials stocks, and the solid and air emissions waste associated with their raw material extraction, processing, and construction and identify key areas of future research necessary to account for ecosystem services in urban sustainability assessments. Based on this preliminary study, the ecosystem service impacts of the building infrastructure of metropolitan Phoenix cover geographical areas multiple orders of magnitude greater than

the political boundary of Maricopa County. The ecological footprint of the building infrastructure in Maricopa County is larger than the entire state of Arizona, and 71% of this impact is from single family detached homes. Additionally, 20,000 square miles of land and 97,000 cubic miles are potentially impacted by acidification and ecotoxicity as a result of the building infrastructure. Although there is substantial uncertainty around these results, this study demonstrates the potential importance of quantifying urban impacts on ecosystems. Developing new, diverse, and regional-specific indicators for LCA is an important next step to reducing uncertainty and capturing the poorly understood categories of ecosystem service impacts.

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Fishman, J., and V. K. Smith.** ***Are Households' Attitudes Toward Ecosystem Services Consistent with Estimates of Economic Tradeoffs to Enhance these Services?

Many local public services and environmental services vary depending on where a person (or household) lives. In the case of environmental services, especially those associated with ecosystems, these differences are often due to a composite of variations in natural conditions along with land use patterns that result from development decisions. This spatial variation, together with increased availability of geo-coded data, has caused renewed interest in a framework introduced by Charles Tiebout (1956) nearly fifty years ago. At the time, he hypothesized it should be possible to uncover people's preferences for local public goods from their choice of a community. In effect, these communities provided the "supermarket" where households could select the best match of local public goods, including environmental services, given their preferences and abilities to pay. Epple and Sieg (1999) offered the first operational strategy for estimating measures of heterogeneous households' preferences for housing and local public goods based on this locational equilibrium. Their framework relies on an important assumption that each household has a latent or unobserved taste for these local public goods with specific properties that allow the implicit "prices" we observe households paying to live in communities to capture the tradeoffs they are prepared to make for these non-market amenities.

This research offers the first test, to our knowledge, of these assumptions. Two data sets are merged for the analysis. The first data set is the PASS 2011 survey completed with CAP LTER support. The second is a constructed data set, designed to match the private, owner occupied, homes in the PASS survey. This second set of information takes advantage of an extensive data set on housing sales in Maricopa County. In addition to detailed information on housing characteristics, these data include variables that serve as indirect measures of ecosystem services. These variables include landscape features (mesic and xeric), proximity to open space, measures of temperature consistent with heat island effects, and elevation. These data have been augmented with air pollution records for EPA's AQI and measures of ambient concentration of PM10.

Attitudinal variables in the Phoenix Area Social Survey (PASS) allow an index of environmental attitudes, the New Ecological Paradigm (NEP), to be constructed. This index has been consistently correlated with measures of individual preferences for environmental and ecosystem services. Thus, our research allows independent measures of the implicit prices for communities to be measured from the housing sales information and these indexes to be compared to estimates of the NEP index for the same communities. Our statistical analysis tests several aspects of the locational equilibrium model. One of the most important findings is that after controlling for air quality, greenery, views (using elevation as a proxy), mean temperature, school quality (using test scores as a proxy), the mean and standard deviation of neighborhood income, and the racial composition of each

neighborhood the Sieg et al. (2002) index of the prices for community (non-market) services is positively related to the corresponding NEP for these same communities.

The implications of these findings are twofold. First, this study provides further evidence that local public goods, both social and environmental, are valuable, and capable of being valued. Second, it provides evidence that there is heterogeneity in consumer preferences for environmental local public goods, and that an index of attitudes consistent with this latent preference is consistent with the assumptions used to estimate modern sorting models. Specifically, pro-environmental attitudes and mean neighborhood income are found to be significantly positively correlated with higher community price indices.

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Gburek, T. M.[1], J. Jewell[2], and J. C. Johnson[2]. *Ecology and Color Morphology of Urban-Dwelling Black Widow Populations.

Understanding the variation between and among species to handle the effects of 'human-induced-rapid-environmental-change' (HIREC) was recently highlighted as a 'grand challenge' for organismal biologists. Urban areas are the most rapidly growing type of environment, thereby dramatically changing the natural landscape, often leading to habitat fragmentation, landscape heterogeneity, and loss of natural habitat. Despite such drastic habitat changes, certain species are flourishing in urban centers and have been termed urban exploiters. The mechanism by which urban exploiters are able to thrive in urban ecosystems is not yet well understood, although it is often thought to be the result of phenotypic plasticity. The Western black widow spider, *Latrodectus hesperus*, is native to the desert Southwest and can be found densely aggregated in urban areas. Recent work on this system indicates that there is a significant effect of habitat fragmentation on black widow mass, population density, and prey abundance. Additionally, adult female *L. hesperus* display a brightly colored red hourglass on their abdomen. We have found this color display to be surprisingly plastic and tightly linked with foraging success. The ecological response of widow populations to spatial variation and the plasticity of their hourglass display may be facilitating a rapid response to urbanization. To document how the ecology and color morphology of urban-dwelling black widows fluctuate over the course of a breeding season, we followed ten individuals from eight urban populations located throughout metropolitan Phoenix, Arizona. Here, we discuss our findings and their implications.

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Gentile, L., J. Tucillo, K. K. Parady, and B. Bolin.** ***Desertification in the Central City: A Political Ecology of the Environmental Change in Phoenix, AZ.

This paper examines the historical geographical formation of a zone of environmental injustice in central Phoenix with a focus on water resource development, land use change, and industrialization in historic minority neighborhoods. Our primary research goal is to document how urbanization processes and concomitant land use and land cover changes beginning in the early 20th Century produced a low income racially segregated region that was denuded of trees and green space. To understand the processes producing these urban environmental changes, we discuss two related domains. First we examine the development of water resources, water law, and agriculture in the Phoenix basin. The establishment of a major irrigated agriculture sector is connected both to early race relations in the region and to the subsequent development of water and transportation infrastructure in 1800s and early 1900s. Next, we discuss urbanization and land use changes in historic barrios in the central city and how these have produced pronounced environmental inequities in historic South Phoenix. Critical factors in this process include the decline of agriculture, the removal of trees in the name of water conservation, and the proliferation of transportation corridors and related urban land uses. These historical geographical processes have produced a region of pronounced environmental injustices from a convergence of industrial and transportation pollution, growing urban heat, and a dearth of public green space in low-income minority neighborhoods at the urban core.

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Hale, R. L.[1], D. Shorts[1], S. Moratto[1], L. Turnbull[2], S. Earl[3], and N. Grimm[1,4].** ***Stormwater Infrastructure Effects on Urban Nitrogen Budgets.

The effects of urbanization on downstream ecosystems, particularly due to changes in nutrient inputs and altered hydrology are well studied. Less is known, however, about nutrient transport and processing within urban watersheds. Previous research has focused on the roles of land cover and land use but drainage system design and configuration also are apt to play a significant role in controlling the transport of water and nutrients downstream. We established a nested stormwater sampling network with 10 watersheds ranging in size from 5 to 22,000 ha in the Indian Bend Wash watershed in Scottsdale, AZ. Small (<200 ha) watersheds had uniform land cover (medium-density residential) but were drained by a variety of infrastructure including pipes, washes, and retention basins. We quantified discharge and precipitation at the outflow of each watershed and collected stormwater and rainfall samples for analyses of dissolved nitrogen species and Cl-. We also measured potential denitrification rates in washes within our sites, and collected soil and pavement samples to describe pools of N within our watersheds. We used these to construct N budgets for each watershed. Infrastructure type strongly affected N retention. Watersheds with surface or pipe drainage were sources of N downstream, whereas watersheds drained by washes or retention basins retained 70-99% of N inputs in rainfall. Event scale N retention was strongly correlated with hydrologic connectivity, as measured by runoff coefficients. Overall, we find that stormwater infrastructure significantly alters hydrologic connectivity and that these changes in hydrology are driving patterns in N export and retention.

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Hall, S. J.[1], S. Yabiku[2], A. York[3], D. Ghimire[4], L. An[5], J. Glick[2], and B. Shrestha[1]. ***Feedbacks Between Human Community Dynamics and Socio-Ecological Vulnerability in a Biodiversity Hotspot.***

Socio-ecological resilience frameworks have emphasized the importance of biophysical diversity and flexible governance institutions to mitigate undesirable consequences of abrupt environmental change. In rural-transitioning communities, however, resource use behaviors are reconfigured by non-family organizations (NFOs; e.g. schools, stores, employers, health clinics) that shift the center of daily activities from inside to outside the family. Unlike governance institutions, NFOs are not collectives that can be easily managed and have no clear responsibilities other than to respond to supply and demand for their services, goods, and experiences. NFOs underpin the rural-to-urban transition, but their role in socio-ecological vulnerability – or their potential to enable or constrain the resilience of management organizations – is largely unknown. In this new project, we will use observational surveys and experiments in a novel design to ask, What factors lead to vulnerability of community forest socio-ecosystems to the catastrophic effects of rapid environmental change?

We hypothesize that the vulnerability of communities near high-value protected areas depends on a range of social and biophysical factors that are linked by household relationships with NFOs. We will test our hypotheses using a unique experimental design, a range of 21 heterogeneous community forest socio-ecosystems in the buffer zone of Chitwan National Park, Nepal, a subtropical biodiversity hotspot that is being rapidly degraded by exotic, invasive plant species. Using an interdisciplinary, mixed-method approach, we will test the importance of diverse social organizations as stewards of socio-ecological resilience in community-based forests through activities that will also aid exotic plant control and restoration of ecosystem services.

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Halpin, R., and J. C. Johnson.** ***Behavioral Syndrome Versus Adaptive Plasticity: Documenting the Foraging, Mating, and Anti-Predator Behavior of Urban and Desert Black Widows.

Individual variations that are both repeatable within a context and correlated across behavioral contexts form suites of correlated behaviors that have been termed 'behavioral syndromes.' Behavioral syndromes are oftentimes regarded as being contrary to optimality theory, which states that individuals should express context-specific behavior, always displaying the behavioral optimum. This controversy has sparked a widespread interest in behavioral syndromes, their implications, and the species in which they are found, as well as potential behavioral syndrome differences across distinct populations. Here we test for the presence of an aggression syndrome in the western Black Widow spider, Latrodectus hesperus. We quantified behavioral variation across three distinct contexts: (1) anti-predator behavior, (2) foraging behavior, and (3) mating behavior. We predicted that (1) an individual's behavior would be repeatable across replicate measures within contexts and (2) behavioral correlations across these contexts would expose a behavioral syndrome. Additionally, we compared these behaviors across urban and desert populations to test the idea that differing selection pressures yield (1) different mean trait values and (2) differences in behavioral syndromes. We predicted that urban spiders would be less

voracious towards prey and less bold towards enemies, and that desert populations would show stronger behavioral correlations. Our results showed no significant correlations across contexts and no significant behavioral differences across desert and urban populations, but did show strong behavioral differences across contexts. This suggests that L. hesperus shows context-specific behavioral plasticity, and therefore these spiders exhibit a high degree of behavioral flexibility, which is ideally suited for urban environments.

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Hartnett, H.[1,2], J. Coe[1], Z. Smith[1], M. Bowman[2], M. Raleigh[3], A. Chesley[2], and G. Pavlovic[2]. *2D Fluorescence Analysis of Dissolved Organic Carbon in Tempe Town Lake*.

We have been monitoring basic water chemistry and dissolved organic carbon (DOC) in Tempe Town Lake since 2005. Dissolved organic carbon concentrations change seasonally and appear to reflect both climatological variation (monsoons) and human water management (dam releases). Fluorescence analysis of dissolved organic carbon can provide information about the types of organic carbon compounds present in the complex mixture. We have generated fluorescence excitation-emission matrices (EEM's) from a suite of samples from Tempe Town Lake collected over the course of 2011-2012. We used the Cory and McKnight (2005) PARAFAC model to assess the distribution of typical aquatic fluorophores over time. EEM's are easy to measure, non-destructive and provide more specific chemical information about DOC composition than other optical techniques (SUVA254).

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Hartnett, H. E.[1,2], and G. A. Hamilton[1]. *Photo-oxidation and Historical Land-Use Change Observations of Soot Black Carbon: A Comparison of Degradation Rates*.

Soot black carbon (BC) is produced from the incomplete combustion of biomass and fossil fuel and is a significant component of the soil organic carbon in central Arizona. Soot BC concentrations in desert areas is low compared to urban areas, suggesting that at least a portion of soot BC is degraded on relatively short time scales. We present two data sets providing evidence that soot BC degradation occurs on monthly time scales. First, relationships between soot BC at urban sites and current and historical land-use information indicate the main input of soot BC comes from recently urbanized sites. Based on the number of years since urbanization, we estimate an environmental soot BC degradation rate of $7x10^{-6}$ g soot BC/kg soil•h. Second, we demonstrate that photochemical degradation of soot BC in both urban and desert soils is possible using environmentally simulated UV and visible light exposure experiments. The decrease in soot BC concentration over 1200 simulated sunlight hours (about 100 days) yields a photochemical degradation rate estimate of $1x10^{-5}$ g soot BC/kg soil•h. The two degradation rates differ by only 18%. The similar rates from the two estimates indicate that soot BC may potentially be degraded more easily than previously considered. Photochemical degradation also alters the chemical structure of soot BC. Fourier-transform infrared (FTIR) spectroscopic analysis indicates the dominant functional groups in soot BC transition from aromatic and aliphatic groups to more oxygenated functional groups such as aldehydes and ketones during photo-oxidation.

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Hernandez, A., M. M. Palta, and N. B. Grimm. Escherichia coli *(*E. coli*) Pulsing and Attenuation in "Accidental" Urban Wetlands.

The aim of this research was to examine the effect of storm events on *E. coli* levels in urban wetland networks in the bed of the Salt River in Phoenix, AZ. The capacity of these wetlands for removing *E. coli* from surface water was also quantified. The wetlands selected for this investigation are "accidental," in that they are fed by storm-water outfalls exiting industrial and residential areas of Phoenix and have consequently developed wetland soils and plant communities. Samples were collected along flowpaths downstream from 6 large, perennially flowing outfalls. Samples were collected weekly during baseflow and immediately after storm events at the following points: immediately downstream of the outfall, mid-wetland, and downstream of the wetland. These samples were then returned to the laboratory, where they were plated within 6 hours of collection on coliform-selective media (Chromocult) and incubated for 24 hours. Plates were used to enumerate both fecal coliform bacteria and *E. coli*. Numbers of *E. coli* collected before storm events were significantly lower than those collected immediately after storm events. These spikes of *E. coli* returned to pre-storm levels rapidly (within a week). *E. coli* levels dropped over the length of flowpaths through the wetlands, indicating high attenuation capability, even during storm events. Wetlands are often constructed or restored to mitigate microbial contamination of wastewater. We therefore expect that given enough time to develop, these "accidental " wetlands can help to reduce the amount of *E. coli* and coliform bacteria reaching rivers from storm and wastewater outfalls.

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Holland, E., L. Pollard, and N. B. Grimm. *An Analysis of Biomass Growth Rates Over Time in a Desert Riparian System.

Nutrient diffusing substrata (NDS) are used to assess nutrient limitation in aquatic ecosystems. The addition of nitrogen in the form of nitrate (NO_3^-) or phosphorus as orthophosphate (PO_4^{3-}) has been shown to dramatically change the amount of algae that can grow in two or three weeks. However, few experiments have been done to show biofilm responses after a three-week incubation period. Our study examined these longer-term growth patterns.

NDS were deployed at Sycamore Creek, a Sonoran Desert stream. They were collected at days 13, 21, 35 and 50 and analyzed for chlorophyll a (chl *a*, i.e., algal biomass) as well as metabolism (gross primary production and community respiration rates, based on oxygen change). These methods were used to analyze and explain the differences in the accrual rate of biofilm over time when exposed to different nutrient treatments.

Analysis revealed that the chl *a* growth patterns are consistent with what would be expected of a nitrogen-limited aquatic ecosystem. The nitrogen-enriched samples displayed an autotrophic tendency while the non-enriched or phosphorus-enriched samples showed a tendency towards heterotrophy.

In theory, growth patterns should tend toward a maximum biomass that could be supported in Sycamore Creek. This plateau point would be determined by exposure to sunlight, macro-invertebrate grazing and space. We hypothesized that all sample types would reach the same plateau point; only the rate of growth would change with the addition

of nutrients. This theoretical plateau point was not reached by any of the sample types in the seven-week experiment.

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Huber, D. P.[1], K. A. Lohse[1], and S. J. Hall[2]. *Climate Controls on the Fate of Anthropogenic Nitrogen Additions in Desert Ecosystems.

Rapid urbanization in arid- and semi-arid regions is increasing nitrogen (N) emissions and deposition yet the fate of this N is poorly constrained. Long-term experimental N additions have shown no significant aboveground shrub response whereas herbaceous cover has responded significantly following average or above average winter rains. Retention of N in surface soils receiving long-term N additions has not been able to explain the fate of the remaining N. Here we show significant storage of anthropogenic N in deep soils (average 84% of applied N) and strong controls of climate on retention of N. Storage of applied ammonium declined linearly and significantly with small increase in precipitation (r^2=0.97) whereas retention of nitrate increased dramatically with small changes in precipitation (r^2= 0.99). Nitrate was also sensitive to small changes in maximum summer temperatures (r^2=0.87). A simple model coupling enzyme kinetics of nitrification to soil water potential in Hydrus 1-D explained much of the excess residual nitrate found in N plots. Our findings suggest small changes in climate, both precipitation and temperature, will likely have profound consequences for the fate of anthropogenic N in desert ecosystems.

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Ibes, D. C. *One Park, Two Park, Green Park, Brown Park: A Classification of Arid Urban Parks and Their Ecosystem Services.

Lack of research on desert city park systems has undermined the potential role of these public amenities in advancing urban sustainability goals. Addressing this gap, this research classifies parks in a large desert city in the Southwest United States--Phoenix, Arizona--with the goal of understanding the park system holistically and multi-dimensionally, providing a baseline to inform public policy and planning aimed at enhancing urban sustainability, particularly by way of increased urban park ecosystem service provisioning. This poster illustrates the classification of urban parks in Phoenix developed through a multi-step quantitative approach. First, 28 variables representing various social, physical, ecological, and urban morphological characteristics of city parks were computed using spatial and archival analysis. Then, two statistical tests were applied to create a multi-dimensional classification of city parks in Phoenix that describes the diversity of these critical urban amenities and their associated ecosystem services. Principal component analysis (PCA) was applied to reduce the data to a suite of critical factors that represent the diversity of park characteristics in the study area. Then, cluster analysis was used to uncover the variation in urban parks based on the differences and similarities within the set of dimensions revealed in the PCA. The resultant park classification is then discussed with regards to specific social, physical, and built characteristics of each type.

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Johnson, J. C.[1], R. Halpin[2], S. Sandrin[1], C. Bauman[2], A. Wirkus Camacho[2], A. J. Diedrich[2], S. Mulk[2], A. Pate[2], N. Planidin[2], E. Slosky[2], J. Urcuyo[2], and K. Landsdowne[2]. *Cannibalism Versus Social Tolerance in an Urban Pest: What Makes Black Widows Want to Kill Each Other?*

In collaboration with students from the Gary K. Herberger Young Scholars Academy, we tested hypotheses regarding social tolerance and cannibalism in the western black widow spider, *Latrodectus hesperus*. Black widows are a superabundant pest species found in dense urban aggregations throughout Phoenix, AZ. A better understanding of what makes black widows tolerant and/or intolerant of conspecifics will help us understand why their urban aggregations can become so dense-often leading to widespread pesticide applications. Specifically, we tested two hypotheses for tolerance in black widows. First, many studies assume intraspecific contests will be dominated by the individual who has established prior residency. Alternatively, these contest outcomes may have more to do with the size asymmetry between contestants. We staged contests in four different groups: 1. Resident large, intruder large, 2. Resident large, intruder small, 3. Resident small, intruder large, 4. Resident small, intruder small.

We predicted that if residency determines these outcomes, then residents should win contests regardless of size parameters. Alternatively, if size asymmetry influences agonism, then asymmetrical size pairings (groups 2 and 3) should lead to more conflict regardless of residency. We present the results of this study and discuss the data's implications for managing urban black widow infestations. In addition, the process of testing these hypotheses was used as a vehicle to introduce young students to the process of science, and we tested the student's understanding of the scientific method before and after the study. We share some of the student's impressions of this exposure to scientific research.

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***Kane, K.[1], J. Tuccillo[2], A. M. York[2], L. Gentile[2], and Y. Ouyang[3]. *Land Use Change and the Urban Landscape: A Spatio-Temporal View of Historical Growth in Phoenix, Arizona*.**

This study develops a spatio-temporal approach to analyze the historical development of a metropolis. While historical narratives provide rich detail, there is also a strong quantitative tradition in urban growth research. Methods from urban growth models, ecological modeling, and spatial analysis provide sharper intuition into the effect that urban change processes have on the growth trajectory of individual land parcels and the entire urban landscape. Phoenix, Arizona is a popular case study for urban growth because of its rapid, decentralized expansion and the hegemony of its suburbs and outlying areas. It is often seen as the epitome of post-World War II suburban sprawl. We digitize parcel maps of downtown Phoenix from 1915, 1949, and 1963 in order to investigate the impact of broader change processes on the city's historic core. Using transition matrices, join-count autocorrelation, and spatial Markov chains, we find that the purported emptying out of the downtown area following World War II was more complex than the common story of retail exodus. Despite an increase in so-called nuisance properties and poor institutional land use controls, nuisance parcels showed a propensity toward aggregation and were decreasingly likely to exist in close proximity to higher-order uses. Finally, we find that Phoenix's downtown is continually homogenizing by land use type. This paper provides a new way to look at the impact that parcel-level change has on urban landscapes, demonstrating the usefulness of a spatio-temporal approach in understanding the development of an urban morphology during a critical period of urban change worldwide.

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Kaplan, S.[1], C. Galletti[1], W. Chow[2], and S. Myint[1]. *Modeling Broadband Albedo with High Resolution Imagery.

Albedo is a key forcing parameter controlling the planetary radiative energy budget and its partitioning between the surface and the atmosphere. Characterizing and developing high resolution albedo for an urban environment is important because of the high global urbanization rate and because the physical processes and spectral characteristics in cities can occur at the scale of 10-20m. We correlate broadband albedo ground measurements from Phoenix, AZ, and reflectance data from QuickBird, to develop a new set of coefficients and assess the feasibility of using high resolution imagery to model broadband albedo. Two wavebands, visible-near infrared (VNIR) and total shortwave albedo, were evaluated for two reflectance models: surface and top-of-atmosphere. The r-square produced from the multiple regression models as well as a pyranometer were used to validate the products generated by the new models. Results show that it is possible to accurately model broadband albedo from high resolution imagery, specifically QuickBird. Model evaluation statistics show that the best model used the Total wavelengths and Surface reflectance. In terms of absolute difference, the best model used top-of-atmosphere reflectance to estimate the broadband albedo in the VNIR waveband with a 1.96% difference compared to the albedo measured by the pyranometer in our study area. The ability to estimate high resolution albedo with high degree of accuracy is particularly important at the neighborhood or sub-city scale where albedo plays an important role in land surface temperatures and urban heat island.

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Lane, S., P. Deviche, and S. Davies. *City Sounds: The Effects of Urbanization on Bird Song.

Urbanization is associated with considerable changes in ecosystem dynamics and these changes may influence the organisms that live in urban environments. Some urban birds produce songs with different characteristics than those of their non-urban counterparts. As song is a crucial aspect of reproduction, changes in song production or structure have the potential to affect breeding success. Northern Mockingbirds, *Mimus polyglottos*, breed in urban and rural environments, but few studies have investigated whether urban and non-urban mockingbirds differ behaviorally or physiologically. The goal of this study was to expand our understanding of the effects of urbanization on bird song by analyzing and comparing the song complexity, measured by repertoire size and average number of notes produced by minute, of urban and non-urban birds. Urban birds sang on average 136 ±13 (mean ±s.e.) notes and produced 155 ±8 notes per minute. These values did not differ from those of non-urban birds (122 ±18 notes and 137 ±21 notes per-minute, respectively). As song was individually quite variable, this result may reflect small sample sizes (n=4) for each type of bird and repeating the study with larger sample sizes may allow for a more confident conclusion. It is also possible that measuring parameters other than repertoire size and notes per minute is needed to separate urban and non-urban birds.

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Larson, K. L.[1], J. Brumand[1,] E. Cook[1], and S. Hall[2]. *The Human Ecology of Residential Landscape Management: Complex Causes, Effects, and Tradeoffs in the Sonoran Desert of Phoenix, AZ.*

The ubiquity of lawns in the U.S. and elsewhere leads to significant demands on water resources, among other implications for society and ecology in cities. Although the monocultural lawn may be heralded for its hyper-green, weed-free aesthetic, which is entrenched in the social-psyche of many suburban residents, concerns about the impacts of landscape management on urban ecology and sustainability (e.g., due to fertilizer and pesticide usage) have risen in recent years and decades. Accordingly, research on the social-ecological causes, consequences, and feedbacks of residents' landscaping decisions has increased. Yet much of this work has been narrow or limited in focus, scale, or approach. This work presents an in-depth, interdisciplinary case study from Phoenix, AZ to demonstrate key findings from multiple studies, specifically in terms of the following themes: complex, counterintuitive and contradictory effects of attitudinal preferences on landscaping decisions; critical tradeoffs among landscape choices, such as 'mesic' lawns versus 'xeric' drought-tolerant alternatives; and, lasting and important role of legacy effects and structural constraints on residents' yard-management decisions. Emerging insights from cross-regional, comparative research will also be addressed, particularly considering the 'homogeneity thesis' that posits sub/urbanization is a standardizing force in landscaping decisions and practices (i.e., following the industrial lawn norm).

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Learned, J.[1], D. Nakase[1], E. Vivoni[2], and S. J. Hall[1]. *Experimentally Validated Mathematical Modeling Reveals the Influence of Surface Rock Cover on Soil Water Availability in a Semi-arid Ecosystem.*

Soil water availability controls primary production in aridlands. While climate is related to production at large scales, landscape and soil features regulate hydrologic processes at smaller scales that are important for plants. Soil surface rocks are common features in drylands, and have been shown to have variable effects on infiltration, evapotranspiration, and runoff. In central Arizona, prehistoric humans manipulated rock distribution for agriculture and settlement construction. Here, we ask, did surface rock manipulation by ancient people leave ecological legacies due to changes in soil water availability? We built an experimentally calibrated model using Hydrus 2D to simulate soil water flow under different rock cover treatments in a semi-arid environment.

Model simulations of volumetric water content following precipitation events strongly matched data from experimental soil boxes under 0%, 20%, 50%, and 90% surface rock cover, with a goodness-of-fit of >80%. As expected, %rock cover was strongly and negatively associated with time-to-runoff. However, rocks were non-linearly related to runoff rate, which declined between 0-50% cover then increased strongly at 90% cover. Net evaporation showed the inverse pattern as runoff, with lowest water loss at 50% and - counter-intuitively - highest evaporative loss at 90% cover due to extended Stage 1 evaporation. Combined, these processes lead to the highest soil water availability for the greatest number of days at moderate (50%) rock cover. This study suggests that relocation of rocks by prehistoric humans has left significant ecological legacies in semi-arid ecosystems through changes in the limiting resource to primary producers.

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Li, X., and Y. Zhang. ***Object-Oriented Land-Cover Classification Using Aerial Photography in Semi-arid Area.***

Detailed land cover mapping for arid area is essential for a range of research issues addressed by the CAP LTER, including all questions about the design or configuration of the land and landscape on ecosystem services and human wellbeing. Our project produces 1-meter land cover map with 16 classes for CAP LTER site. The primary data sources include the 4 bands aerial imagery acquired from the National Agricultural Imagery Program in 2010, and cadastral GIS vector layers. Adopting the object-oriented techniques, a rule-based expert system approach is designed to cluster pixels into meaningful objects based on their spectral, spatial, and contextual properties.

Comparing the fine scale mapping results with other LTER sites (e.g., PIE LTER, BES LTER), we encounter challenges in both urban universal classification systems and the unique desert landscape in CAP LTER site. Additionally, due to the high level of landscape heterogeneity and the diverse variation of object composition from the urban core to the desert fringe, several systematic issues exist in the result product: (1) difficulties in delineating residential building boundaries from their surrounding drive ways and bare soil in urban/rural areas; (2) separation of seasonal river beds from soil and rock in rural areas; and (3) separation of big shrub from tree canopies in urban areas.

These issues are mainly attributed to the current lack of the elevation information within the urban area and the increase of spectral interference within in the high resolution data. Post classification process and additional manual editing were conducted to reduce errors within the classification results.

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Lorenz, D., M. Georgescu, and A. Brazel.** ***Assessing Climate Impacts of Projected Continental U.S. Urban Expansion.

Today, roughly half of the world's population lives in urban areas and, according to the United Nations, the share of global urban dwellers is expected to surpass 60% by 2050. Potentially adverse effects of urbanization on climate have already been shown for Arizona's rapidly expanding Sun Corridor, highlighting the importance of assessing regional-scale impacts of widespread urbanization. Here, urban expansion scenarios developed by the EPA for the contiguous United States are incorporated into a state-of-the-art earth system model accounting for detailed treatment of urban processes, and multi-year simulations are conducted with both a contemporary and projected urban growth scenarios. Urban representation is integrated within the "Weather Research and Forecasting System [WRF]" modeling system and both seasonal and annually averaged climatic impacts of end-of-century U.S. urbanization are quantified. Impacts of future expansion are compared to a baseline scenario using an EPA assessment of modern day (i.e., 2006) urban representation.

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Loza Morales, D. E.[1], D. L. Childers[2], A. Evans[3], A. Evans[3], C. A. Sanchez[4], and N. Weller[2]. *Macrophyte Decomposition Rates in the Tres Rios Constructed Treatment Wetland: Preliminary Results.

Constructed treatment wetlands perform important ecosystem services in many cities by acting as tertiary wastewater treatment. We are investigating ecosystem functions related to important water treatment services at the City of Phoenix's Tres Rios constructed treatment wetland. This wetland produces more than 600 metric tons of plant biomass every year, all of which senesces in the winter. Critical questions that we are pursuing include: 1) How rapidly this biomass decomposes, and; 2) What is the fate of the nutrients bound up in this decomposing biomass? We are answering these questions with a standard litter decomposition experiment, begun in July 2012. Our experimental design follows a 3X3 factorial format, with 3 transects located along the primary flowpath of the system and 3 sites along each transect, from near the open water to near the shore. We divided the 6 primary plant species in the system into 3 morphotypes: 1) *Typha latifolia* + *T. domingensis*; 2) *Schoenoplectus acutus* + *S. tabernaemontani* + *S. californicus*; 3) *Schoenoplectus americanus*. At each of the 9 locations we deployed 8 litterbags for each morphotype, with approximately 15-20 gdw of senesced plant material. One bag from each was harvested after 1, 2, and 4 months in the field, and we will continue to harvest the bags every 2 months. Our preliminary results show rapid weight loss in the first month of up to 25%, but surprisingly little difference among the 3 plant morphotypes. Our preliminary analyses focus on comparing within-transect variance with whole system variance, as well as within-morphotype variance.

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Marusenko, Y., F. Garcia-Pichel, and S. J. Hall. *Nitrogen Fertilization Creates New Niches for Ammonia-Oxidizing Microbial Communities in Aridland Soil.

Soil archaea and bacteria oxidize ammonia to nitrite in a key step of nitrification, which may be affected by nitrogen (N) inputs from anthropogenic sources (e.g., atmospheric deposition). Most research has shown that N enrichment changes composition of ammonia-oxidizing communities, increases population density, and elevates ammonia oxidation (AO) rates. However, distinct adaptations to environmental change within the archaea and bacteria may alter the enzymatic potential of ammonia-oxidizers, leading to distinct ecosystem responses.

We asked if N enrichment affects the ecology of AO through selective effects on particular microorganisms and their function at the physiological level. We measured AO in soils from N fertilized and unfertilized Sonoran Desert soils near Phoenix, Arizona. Soils were collected in common patch types in aridlands, away from plants and under the canopy of creosote bush shrubs. In the lab, we measured AO rates under a range of ammonium concentrations to evaluate the enzyme kinetics of ammonia-oxidizing communities. Additionally, ammonia-oxidizers were characterized using real-time PCR and pyrosequencing.

As predicted, N fertilization increased the number of ammonia-oxidizing cells and AO rates in soil. However, N fertilization also increased the amount of ammonium oxidized per cell, and the community diversity (richness and evenness). In addition, while both archaeal and bacterial abundance respond positively to N enrichment at the domain-level, individual clades respond positively or negatively at the species-level. These results suggest that N enrichment in aridlands changes soil ammonia-oxidizers through shifts in community structure and population size, resulting in enhanced nutrient cycling rates at the ecosystem scale.

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McAlister, A., A. Wutich, A. Brewis, J. Maupin, and D. Hruschka. *Global Convergences and Divergences in Ethnotheories of Climate Change and Disease.

Using interviews conducted with 739 adults in nine different global locations (including Phoenix, Arizona), we tested for commonalities in how people culturally understand connections between climate change and disease. Based on consensus analysis, we find evidence of shared cultural ideas about the connections between climate change and disease both within locations, with some key differences across locations. Comparison of IPCC and public understandings of specific climate change-disease connections showed some agreement, with some specific areas of clear disagreement. We suggest that more public health education regarding the current and anticipated effects of climate change on disease is needed, and that sophisticated messaging that reflects local ecological risk factors and prevention strategies may be particularly important in disease prevention efforts.

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Middel, A.[1], K. Hab[2], A. J. Brazel[3], C. Martin[4], and S. Guhathakurta[5]. *Impact of Urban Form and Design on Mid-Afternoon Microclimate in Phoenix Neighborhoods*.

Many cities, especially those in arid and semiarid environments, are warming due to urban heat island (UHI) effects, induced by changes in land cover and built forms. Those local climate variations lead to a higher demand for air conditioning in the summer and increased human discomfort.

This study investigates the impact of urban form and landscaping on the microclimate in Phoenix, Arizona. We used the three-dimensional microclimate model ENVI-met® to simulate near-ground air temperatures for typical neighborhoods in Phoenix. First, ENVI-met® was calibrated using the CAP LTER North Desert Village (NDV) landscape experiment at Arizona State University's Polytechnic campus. This site is an ideal test bed to determine the model's input parameters since it is a controlled environment recreating four prevailing residential landscape types in the Phoenix metropolitan area (mesic, oasis, xeric, native). After calibration, we designed urban form and landscaping scenarios that represent a realistic cross-section of typical residential neighborhoods in Phoenix. To find the most effective urban form and design strategies to ameliorate temperatures during the summer months and, consequently, to reduce residential energy use, simulation results were analyzed in terms of mid-afternoon air temperature distributions, ventilation, and their relationship to parameters such as sky-view factor and related short-wave radiation.

Mesic landscapes provided the expected cooling by several °C during the day compared to oasis, xeric, and native ones. However, the building characteristics (height, orientation and distribution) further determined within-design spatial differences in cooling, strongly related to the solar radiation and local shading patterns.

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***Mousel, M., M. Giraudeau, and K. McGraw. *Parasites in the City*.**

Urbanization is an ongoing worldwide process occurring at a growing rate. Half of the human population now lives in cities and the UN World Urbanization Prospects report predicts that 60% of the inhabitants of our planet will reside in urban environments by 2030 (UNPD 2005), leading to a dramatic increase in the size of urban centers. This land-use change is expected to have a considerable impact on ecosystems, wildlife biodiversity and animal ecology. Although studies have documented demographic changes in wildlife resulting from urban development, only recently have the physiological consequences of urbanization been examined. For example, a crucial factor that was seldom considered is the health and/or parasitic rate of urban populations compared to rural ones. Here, we monitored the degree of gut infection by coccidian parasites in male House Finches (*Haemorhous mexicanus*). This was conducted during the molt period and along a gradient of urbanization in the Phoenix metropolitan area. We found that gut parasitism is positively and significantly correlated with the degree of urbanization (population density). Our results suggest that the chronic stress experienced by urban birds may have significant effects on their immunity and susceptibility to parasites.

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Nzengya, D., and R. Aggarwal. *The Impact of School-Based Participatory Water Testing Program on Knowledge and Behavior Related to Safe Water and Hygiene in Kenya.

The study tested the effectiveness of school-based health education interventions that combine hygiene messages with participatory water testing in changing perceptions, attitudes and practices related to safe water handling and hygiene among students and families. Water-borne illnesses due to poor water quality and hygiene continue to be leading causes of school children absenteeism in peri-urban schools in Western Kenya. Although there have been enhanced efforts by government agencies and NGOs over the past decade to provide primary schools with safe water infrastructure, preliminary evidence suggests that school children and their families continue to rely heavily on alternative non-improved water sources. This raises important questions regarding how far the current efforts by government agencies and NGOS are meeting the needs of children and how a more sustainable model can be designed. The study used baselines quizzes and involved a pre-test of students' knowledge about hygiene, and water handling practices and diarrhea. Participants were 120 middle school students. After the baseline quizzes, 40 students from two schools underwent health communication training with hygiene messages only, 40 students in two schools underwent health communication training combined with participatory water testing, and the rest in two schools had no intervention. An identical post-test quiz was administered to all participants one week after the intervention. Preliminary analysis found significant differences in improvement in knowledge between groups, with recipients of hygiene messages combined with water testing showing higher mean scores than recipients of health communication messages. The implications of preliminary results on the design of safe water and hygiene education programs in schools are discussed.

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Ouyang, Y.[1], E. Wentz[2], B. Ruddell[3], and S. Harlan[4]. *A Multi-Scale Analysis of Single Family Residential Water Consumption in the Phoenix Metropolitan Area.

Studies on residential water demand typically focus on one single spatial scale, especially using aggregated scale data since data on the household scale are often not available. We compare the relationship of monthly single-family water use with its determinants by using longitudinal data in 2000 and 2001 on three spatial scales (household, census tract, and city/town) and employing the linear mixed-effects model. We find that similar results are obtained on the household and census tract scales, while the big difference of the city/town scale in the parameter estimates compared to the first two scales indicates the spatial heterogeneity in the relationship of single-family water use with its determinants among cities and towns in the metropolitan area. These results are based on the assumption of no spatial dependence among spatial units on the same scale. Therefore, our next research plan is to examine the spatial pattern of the relationship between single-family water consumption and its determinants and how this spatial pattern changed over the period of 2000-2009 by using the geographically weighted regression model.

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Palta, M. M.[1], P. Groffman[2], and S. Findlay[2]. *Use of Nitrogen Budgets and N_2 Flux Measurements to Estimate the Role of Denitrification in Brownfield Stormwater Wetlands*.

Wetlands are constructed or restored in urban areas to reduce inorganic nitrogen (N) contamination of surface water runoff. Few studies, however, have examined the performance of unrestored but highly impacted wetlands within an urban context. These wetlands tend to be the primary recipient of nitrate (NO_{3-})-enriched storm and rainwater due to their ubiquity in low-lying portions of the landscape. Studies anticipate high rates of NO_{3-} removal via the microbial process of denitrification when labile carbon, and NO_{3-} are high and O_2 is low. Denitrification estimates are compromised, however, by our inability to accurately measure N_2 flux. In this study, we calculated loading rates of inorganic N and used measurements of N_2/Ar, O_2/Ar, and NO_{3-} flux in sediments to generate inorganic N budgets for brownfield stormwater wetland sites. Loading of inorganic N via rain and stormwater was high, and large amounts of NH_{4+} were created from mineralization of decomposing organic matter. Hydrology was a strong driving force of N_2 flux; lowering of the water table allowed surface sediments to oxidize, leading to production of NO_{3-}, which fueled N_2 production lower in the sediment profile. Overall, the wetlands are denitrifying at a rate of around 620-2,580 µg N/m^2/day. Flux of NO_{3-} out of sediments was occasionally higher, likely due to plant uptake. These wetlands appeared to be serving as a sink for NO_{3-}, but were net sources of NH_{4+}; periodic drainage of the wetlands to promote oxidation of NH_{4+} may be a strategy for promoting higher inorganic N removal from these sites.

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Palta, M. M.[1], and H. E. Hartnett[2,3]. *Assessment of Temporal Patterns in Dissolved Organic Carbon in Tempe Town Lake.*

We assess a seven-year time series of dissolved organic carbon (DOC) in Tempe Town Lake and examine relationships among DOC, discharge, rainfall, season, and basic water

quality parameters. The data were collected on a roughly daily-to-weekly timescale (with notable exceptions in 2006 and 2010). We explore three patterns potentially determinant of DOC concentration: 1. Increases in DOC corresponding to upstream dam releases on the Verde and the Salt Rivers, 2. Increases in DOC after significant rain events, suggesting stormwater is a significant source DOC to the lake, 3. Decreases in DOC during hot, dry (evaporative) periods. We will assess the latter pattern by comparing endogenous processing vs. export using discharge measurements at the downstream end of the lake to constrain water transport. Water clarity and algal growth are important considerations for the recreational services provided by the lake; both are highly related to DOC dynamics. We will evaluate biogeochemical and hydrological drivers of DOC and water clarity.

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Quay, R.[1], A. Miller[2], and P. Nagel[3]. *Exploring the Uncertainty within Residential Water Demand*.

In the past water resource managers assumed that the factors driving water demand were for the most part stationary and used simple planning assumptions about demand that were based on patterns of historical water demand over the last few decades. These simple assumptions formed the basis for the design of water conservation programs and projections of future water demand used to design infrastructure and water resource plans. However over the last few years water managers have begun to realize that the patterns of water use in their communities are not stationary and in fact are subject to high levels of uncertainty. Because of this uncertainty, many of these assumptions are now in question. This uncertainty comes from two primary causes, 1) the high level of variation that exits within residential water demand by individual customers, and 2) the uncertainty about the future of factors that impact residential water demand such as water price, lot size, density, cultural norms for water use, technology of indoor and outdoor water fixtures, landscaping, climate change (temperature and precipitation), and economic trends. This poster presents some interim results of collaborative research to explore and describe the patterns of uncertainty within residential water demand for case study cities in Arizona and what these patterns of uncertainty may mean for planning future water demand.

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Ramos, J.[1], E. J. Chapman[1], N. A. Weller[2], and D. L. Childers[2]. *Greenhouse Gas Emissions from a Constructed Wetland System in Phoenix, AZ.

Wetlands support ecological functions that result in valuable services to society, including the purification of water through processes such as denitrification, plant uptake, and soil retention. Wetlands are also significant sources of greenhouse gases, such as nitrous oxide (N_2O), methane (CH_4), and carbon dioxide (CO_2). Many free-water surface constructed treatment wetland systems (CWS) in North America have been developed to remove nutrients from secondarily treated water, but little is known about the contributions of CWS on greenhouse gas emissions, especially in arid regions. We proposed to link ongoing denitrification and plant uptake investigations in the Tres Rios CWS in Phoenix, AZ to quantify the greenhouse gas fluxes of N_2O, CH_4, and CO_2. Since the spring of 2012, we have

been utilizing the floating chamber technique to collect and measure gas samples from three subsites (shoreline, vegetation, and open water) along two transects within the CWS. Since starting these observations in the spring of 2012, averaged CO_2 fluxes (17.56 µg CO_2-C cm^{-2} hr^{-1}) were greater than averaged CH_4 (1.31 µg CH_4-C cm^{-2} hr^{-1}) and averaged N_2O (0.06 µg N_2O-N cm^{-2} hr^{-1}) across the CWS. These preliminary observations indicate slight differences in CO_2 fluxes at vegetation and shoreline subsites between inflow and outflow. Methane fluxes describe a decreasing flux gradient from the shoreline to open water subsites in both transects in May and July. We expect that our results will show what tradeoffs exist between the ecosystem processes desired from the CWS and greenhouse gas emissions in an arid-urban region.

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Rice, J., and P. Westerhoff.** ***How Much Wastewater is in Central Arizona Project Source Waters?

The goal of this summer project was to quantify the percentage of wastewater effluent throughout Central Arizona-Phoenix source waters by analyzing sucralose as a wastewater tracer. Due to the persistence of sucralose in the environment it has been analyzed as a tracer of wastewater effluent. The Colorado River contains 1-2% wastewater from Las Vegas downstream of Lake Mead, and additional contributions in Lake Havasu increase those – during average flow conditions. During drought conditions, Colorado River water may contain 14% wastewater at the point where Arizona withdrawals water. Throughout the Southwest, stress on water resources will increasingly contain larger percentages of wastewaters that affect water quality. This project will quantify the extent to which wastewater effluents are present throughout Phoenix water sources during the summer months of 2012. Grab samples were collected from eight sites along the Central Arizona Project (CAP) system, six sites within the Salt and Verde River watersheds and from three Phoenix area wastewater treatment plants. The samples were concentrated by solid phase extraction and analyzed using LC/MS. Wastewater percentages ranged from below detection to 9.4% within source waters.

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Rosales Chavez, J., A. Wutich, A. Brewis, A. M. York, and R. Stotts.** ***Rules, Norms, and Injustice: A Cross-Cultural Study of Perceptions of Justice in Water Institutions.

Access to water is often inequitable, and perceived as unjust by stakeholders. Based on qualitative analysis of 135 ethnographic interviews in Bolivia, Fiji, Arizona, and New Zealand, we conduct a cross-cultural analysis to test for shared notions of justice in water institutions (i.e., rules, norms). A key finding is that institutional rules are a common concern in evaluations of justice, but institutional norms were prominent in justice evaluations only in the Bolivia site (where water access problems are most acute). Similarly, while concerns related to distributive and procedural justice were widely shared across community sites, interactional justice was only a salient concern in Bolivia. We propose that the study of water and other natural resource institutions will benefit from an expanded concept of environmental justice that includes interactional injustices and also a more explicit analytic focus on institutional norms, particularly for communities that face resource scarcity and less-developed economic conditions.

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Rushforth, R. R.[1], E. A. Adams[2], and B. L. Ruddell[3]. *Embedded Resource Accounting: Generalized Ecological, Water and Carbon Footprint Methodologies.

This poster describes the Embedded Resources Accounting (ERA) framework as a theoretical generalization of ecological, water and carbon footprint methodologies. ERA synthesizes footprinting, material flow, and "virtual" accounting approaches for the management of arbitrarily defined resource stocks. The specific simplifying assumptions made in the ecological, water, and carbon footprint methodologies and standards are explained, and possible variations discussed. The paper concludes with a discussion of how the role and worldview of a resource manager determines the assumptions made in the calculation of resource footprints and how the ERA framework helps to explicate the impact of roles and worldviews in resource management.

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Sampson, D. A., and R. Quay. *High Probability of Near-Term Shortages for the Central Arizona Project: Surface Water Reductions and the Assured Water Supply Program (Simulations Using WaterSim 5).*

As a boundary organization the Decision Center for a Desert City (DCDC) promotes collaboration between scientists and decision makers. Our mission is to bridge science and policy (to foster knowledge-based decision making) and to study how decisions are made in the face of uncertainty. DCDC's water policy and management model for the Phoenix metropolitan area, termed WaterSim, represents one such bridging mechanism. We have structured WaterSim 5 to create an advanced scenario-generator framework. This structure enables one to create an unlimited number of scenarios of potential water futures as influenced by policy, and the probable changes in future water supplies and demand. In this contribution we simulated the probable effects of climate change on riverine runoff and, subsequently, water supplies and water governance. Specifically, we varied runoff from 85% of historical to 110 % of historical using a 30-year indexed sequential method to incorporate potential hydrologic variability for both the Colorado River (Central Arizona Project; CAP), and the Salt-Tonto-Verde Rivers (STV) (Salt River Project; SRP). We then examined the variability of the Colorado River flows on Lake Mead elevations and, thus, CAP deliveries, and the variability of the STV flows on reservoir operations and, thus, SRP deliveries. The short-term cascading impacts of reduced surface water deliveries to the Phoenix metropolitan area were followed through time to assess how the implementation of the assured water supply (AWS) program of the 1980 Groundwater Management act might respond. We present validation simulations to support our shortage probabilities and AWS conclusions.

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Sanchez, C. A., D. L. Childers, L. J. Turnbull, and N. A. Weller. *The Contribution of Evapotransportation to the Annual Water Budget of an Aridland Urban Wastewater Treatment Wetland.

Background/Questions/Methods: One of the most important aspects of systems-level analysis of wetlands is the water budget. Quantifying how evaporation and evapotranspiration contribute to water residence time is crucial to understanding the cycling of biogeochemically active and non-active solutes through the water column, plants and soils-particularly in arid climates. Since June 2011, we have collected bi-monthly measurements of evapotranspiration, evaporation, and conductivity in the Tres Rios constructed treatment wetland. Our primary objectives were: 1) to determine species-specific transpiration rates using a handheld infrared gas analyzer (IRGA); 2) quantify aboveground biomass and species composition of the plant community, and; 3) calculate a whole-system annual water budget using these rates plus inflow and outflow data. We hypothesized that; 1) leaf-specific transpiration rates are controlled by photosynthetically-active radiation, relative humidity, and air temperature, but: 2) annual evapotranspirative water losses will be driven by seasonality in macrophyte biomass and community composition. We are working with the City of Phoenix on an adaptive management plan for the Tres Rios treatment wetlands that will maximize the ecosystem services provided by the wetland, and this water budget is an important component of the management plan.

Results/Conclusions: We combined our bi-monthly IRGA measurements with data from a nearby meteorological station and plant biomass sampling to scale our leaf-specific rates to the entire system. Daily evapotranspirative losses ranged from near 0 in the winter to 6.5 cm day-1 during the summer. These values are 5-10 times higher than published results from mesic wetlands. These losses represented up to 6-8% of the total effluent inflow to the system during the summer. We observed that seasonal variations in plant biomass affected total evapotranspirative losses. On the average, *Typha latifolia* and *domingensis* and *Schoenoplectus acutus* transpired 4-5 times more water than *S. americanus* and *S. tabernaemontani*. These interspecies differences were driven by differences in plant-specific biomass, plant-specific transpiration rates, and relative proportion of each species to whole-system biomass. Bi-monthly measurements of conductivity showed increases of up to 25% along transects within the wetlands from open water to the shoreline, suggesting that the evapoconcentration of nutrients and solutes is occurring. This poster and research project is part of a broader effort to understand the ability of wetlands in arid climates to deliver ecosystem services related to wastewater treatment.

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***Shorts, D.[1], R. L. Hale[1], S. Earl[2], and N. B. Grimm[1,2]. *Hydrological and Geochemical Effects on Denitrification Potential in an Arid, Urban Wash*.**

Although the absence of nitrogen (N) can be detrimental to many biological processes, in large quantities certain forms of N can be harmful to the environment. N deposits can leak down through the soil and accumulate in groundwater stores, lakes, and other bodies of water. In arid, residential watersheds, N accumulates by fertilization, atmospheric deposition, and litter from residents and is transported to washes during storms. The main goal of this research is to ascertain how geochemical and hydrological factors limit denitrification and, therefore, affect the quantities of N exported from such a wash. In this study, we evaluate the effects of factors including moisture content, soil texture, and N concentrations on denitrification in a residential, desert wash. In order to carry out our research, we sampled soil from a wash in Scottsdale, AZ during summer 2012. Denitrification enzyme assays were used to measure potential denitrifcation rates within the

wash. Furthermore, data on soil moisture content, soil texture, and N concentrations (nitrate [NO3] and ammonia [NH4]) were collected from various points within the wash. It was found that potential denitrification rates averaged 13.2 (±48.6) mg kg^{-1} h^{-1}, and ranged from -5.15 to 261.27 mg $kg^{-1}h^{-1}$. In comparison with denitrification potentials of floodplain soils from Indian Bend Wash and its retention basins (Phoenix metropolitan area), these rates are an order of magnitude higher. Moreover, they suggest that the potential to remove N from storm water is very strong in these engineered washes.

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Song, J., J. Yang, and Z. Wang.** ***Modeling CAP LTER Flux Tower Measurements Using an Advanced Urban Canopy Model.

Rapid urbanization has emerged as the source of many adverse urban environmental problems due to rapidly growing anthropogenic stresses. Last decade has seen increasing research effort devoted to parameterize urban surface energy exchange processes that hold a key to solving the environmental problems. Among these models, the Arizona Single Layer Urban Model (ASLUM) we developed here is capable of predicting surface energy budget partitioning, facet and soil temperatures, and volumetric soil moisture profiles for a variety of urban land use land cover types. ASLUM is a "state-of-the-art" urban canopy model that features: (1) an improved resolution of urban facet (viz. roofs, walls, or roads) heterogeneity; (2) an analytically-tractable algorithm for heat conduction in building envelops and soils; and (3) a built-in urban hydrological model for realistic prediction of evaporation process. In this study, we applied ASLUM to simulate the field measurements of surface energy budgets obtained by the CAP LTER eddy covariance tower at the Maryvale (West Phoenix) site, for both pre-monsoon and monsoon seasons. In addition, model predictions are compared with a wireless sensor network measurement of surface temperature for different pavement types (concrete, asphalt, landscape gravel and green turf). Results of comparison show a good agreement between the model predictions and the field measurements, indicating that ASLUM is a useful numerical tool for capturing surface energy and water exchange in urban areas and can be extended to provide guidance for urban hydrometeorological services.

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Stromberg, J.[1], H. Bateman[2], J. Foutz-Sweat[1], D. Wolkis[1], B. Scott[1], A. Suchy[1], E. Makings[1], and N. Wilson[1]. ***Just Add Water: Benefits of Passive Restoration in an Urban Floodplain.***

As the world urbanizes, efforts to restore urban rivers are on the rise. However, despite high costs, river restoration does not always accomplish its goals. Species diversity can increase but often not to levels seen at reference sites. In addition to planned restorations, urban waterways also support wetlands at storm drains and effluent discharge points. Information is lacking on whether these serendipitous (and inexpensive) wetlands provide services on par with those at restored and reference sites. To address this question, we selected six, 1-km reaches along the regulated Salt River: three are near storm drains, two have been actively restored, and one is a non-urban control.

Ecosystem assessment should encompass structure and function of multiple taxa. Thus, we sampled stream water quality as well as abundance, composition and diversity of plant and animal communities. We collected data in multiple seasons along three cross-floodplain transects per reach. Herpetofauna were quantified using visual-encounter-surveys; birds using point-counts; bees with aerial nets and pan traps; macroinvertebrates using D-frame

nets; and plant cover in quadrats. We analyzed data with non-metric multidimensional scaling ordination.

Although each taxonomic group showed distinct patterns, overall, biotic richness and composition showed high overlap between an actively restored site and the two perennially-wet serendipitous wetlands. The non-urban control had higher numbers of desert species than other sites, while the dry (ephemerally flowing) outfall had low numbers of wetland taxa. Bees had greatest diversity at the drier and less densely forested sites. As we continue our monitoring, we will provide recommendations to managers of urban natural areas.

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Tarrant, P., D. Julian, and R. Raub. ***The Virtual Notebook: A "TurboTax®" Approach to Improving Research Metadata.***

A major challenge for all research institutions is the long-term curation of digital research data. This challenge is complex in nature, covering not only the collection and storage of multiple data formats, but also the creation of relevant (and sufficient) metadata. A key aspect of this challenge is that the creation of dataset metadata can be an afterthought, prepared by an investigator who is focused on new research activities in order to meet data publication commitments.

The CAP Information Manager and the Informatics team at the Global Institute of Sustainability are focused on developing a new knowledge management system, referred to as a "virtual notebook," which will aid researchers in managing project related data and help them prepare their data for long-term curation and publication.

This system will address a major root cause of poor metadata quality, i.e., the temporal disconnect between data creation and metadata preparation. This system will encourage the incremental development of all information associated with a research project, including the creation of project abstracts, methods, protocols and dataset metadata. Programming interfaces will support dataset ingestion by the LTER Network Information System as well as the Arizona State University Digital Repository.

Global Institute of Sustainability, Arizona State University, PO Box 875402, Tempe, AZ 85287-5402

Trubl, P.[1], and J. C. Johnson[2].** ***Population Ecology and Stoichiometry of the Western Black Widow Spider: From Solitary Desert Predator to Urban Pest.

Human-induced rapid environmental change (HIREC) influences nearly all of Earth's ecosystems through processes such as urbanization. For instance, urbanization influences biodiversity patterns, often yielding an increase in the abundance of a few urban-adapted taxa at the expense of native species diversity. The western black widow spider, *Latrodectus hesperus*, is a pest species that often forms dense urban subpopulations relative to the low-density subpopulations found throughout undisturbed, desert habitat. The population ecology of ten spider subpopulations spread across metropolitan Phoenix, AZ was examined during the peak breeding season (June-August). Prey abundance, female mass and population density showed significant spatial variation across subpopulations. Additionally, prey abundance was a strong determinant of female mass and population density within each subpopulation.

Ecological stoichiometry was used to examine the nutrient (nitrogen and phosphorus) composition of spiders and prey from urban habitat, desert habitat and a laboratory diet regime. We found that 1) spiders are more nutrient rich than crickets in the field, 2) spider

subpopulations exhibit significant spatial variation in their nitrogen composition, 3) nutrient composition of urban spider subpopulations does not differ significantly from desert subpopulations, 4) laboratory-reared spiders fed a diet of only laboratory-reared crickets are more nitrogen and phosphorus limited than field-captured spiders, and 5) cannibalism by laboratory-reared spiders alleviated phosphorus limitation, but not nitrogen limitation, when compared to field-captured spiders. The integration of population ecology and stoichiometry illustrates the need to address mechanisms like nutrient limitation that may explain why urban pest populations thrive and native species diversity suffers following HIREC.

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Tuccillo, J., and C. Van Gijlswijk. ***Peopling Phoenix's Past: Examining Spatial Demography in Early Central Phoenix Using Historical United States Census Records.***

This poster illustrates preliminary efforts by the Phoenix Spatial History Project, part of the Late Lessons from Early History initiative at Arizona State University's School of Human Evolution and Social Change, to generate historical parcel-level demographic data from US Census longforms for Phoenix, 1920-1940. Into Spring 2013, we intend to pair these data with early 20th Century land-use data derived at the same scale from Sanborn Fire Insurance Maps. Our initial case study examines part of the Downtown Phoenix Urban Form Project boundary, spanning east from 7th Avenue to 7th Street and south from Roosevelt Street to Buckeye Road.

We observe prevalent patterns of north-south spatial segregation in early Phoenix by race, 1920-1940, corresponding both with home/rent values present for 1930 and 1940 and zoning districts. Commercial and Light Industrial zoning types, in our study of land-use and zoning in early Phoenix, 1915-1949, were found to propagate nuisance and hazard land-uses in Phoenix's aging neighborhoods. For each time point, we find almost exclusively white populations residing in high-to-mid-value Multifamily Residential zones north of Van Buren Street, mixed races in variable-value Commercial zones south towards the Southern Pacific Railroad, and largely devalued, minority-populated neighborhoods in the Light Industrial, Commercial, and Residential zones south towards Buckeye Road.

Finally, in an additional exploratory attempt to link these data with normalized census tract boundaries for 1970-2010, we witness overall gradual population decreases amid influxes of Hispanic/Latino residents in each tract until 2000 and increases in population growth with slight shifts in racial composition during downtown revitalization efforts, 2000-2010.

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Vins, H.[1], C. Kunzweiler[2], C. Roberts[1], M. Beresford[1], A. Wutich[1], and A. Brewis[1].** ***Gender Differences in Perceptions of Water in Arizona: Insights from the Science of Water Arts Project.

The Science of Water Art project is a collaborative work that brings together professionals, community members, college students and children to think about the role that water plays in each of our lives. Using a sample of 4th grade classrooms in Maricopa County, over 3,000 drawings of children's perception of water today and in the future were collected. The 9-11 year olds were asked to draw pictures of 1) how they saw water being used in their neighborhood today (T1), and 2) how they imagined water would be used in their neighborhood 100 years from now (T2). The artwork was then collected and coded for nine different themes, including: vegetation, scarcity, pollution, commercial sources of

water, existing technology, technology innovation, recreational use, domestic use, and natural sources of water. Statistically significant differences were found between T1 and T2 for all codes and between boys and girls for several codes. Ecological and demographic data for the participating schools have also been linked to each piece of artwork and are being analyzed for significance. This project allows for a look into how climate change and water insecurity is viewed by younger generations and gives a voice to children so that they may share their outlooks on this vital resource.

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Warren, P.[1], C. Nicolson[1], M. Strohbach[1], R. Ryan[2], C. Polsky[3], C. Chen[2], R. Danford[1], V. Wolff[4]. *Quantifying Effects of Urban Growth and Urban Greening – Preliminary Findings from a Stakeholder-Driven Scenario Analysis.*

Cities worldwide are experiencing both inexorable urban growth and, to varying extents, municipally supported efforts toward urban greening, but the relationship between these two processes are not well understood. Scenario analysis provides a tool to explore a range of potential future combinations of greening and growth, following contrasting trajectories of change. The Boston metropolitan area is the 10th most populous region in the United States with 4.48 million people. Despite relatively low levels of population growth in the next 20 years, the metropolitan area is expected to consume 152,000 acres of open space, including 58,000 acres of rare and endangered species habitat. Dealing with this predicted growth will require proactive landscape planning in the developing urban fringe, as well as increased "greening" of the existing densely populated urban core. Through a stakeholder-driven scenario analysis, we are examining the effects of four different futures for the Boston Metropolitan region, including an uncontrolled growth scenario (Current Trends) and three versions of controlled growth, based in part on the Metropolitan Area Planning council's long term strategic planning efforts (Green Equity, MetroFuture, and Compact Core). Each of these latter three emphasizes compact development, but they differ in the degree to which growth would occur in the suburbs versus the urban core. The scenarios also differ in the degree of investment in literal greening (urban tree canopy). Scenarios were identified, selected and refined with input from a diverse group of city and state level policy leaders. Analyses are ongoing, but preliminary results indicate that it is difficult to achieve some of the desired outcomes identified by stakeholders, such as social equity with respect to urban tree canopy. Increases in biodiversity through greening investments within the city might come at a significant cost to land conservation in the broader region if not accompanied aggressive redevelopment.

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***Weaver, M., K. J. McGraw, and M. Mousel. *Avian Anthrophobia? Stress Response of House Finches (*Haemorhous mexicanus*) Across an Urban Gradient in the Presence of Humans*.**

Urban environments present animals with many novel experiences, not the least of which is the physical presence or threat of more humans. Cities are typically thought to harbor fewer predatory threats to wildlife because many native predators are not found in human-impacted areas. However, most studies on urban predation do not take human

presence into account. In this study, we examined behavioral and physiological responses to human presence in house finches (*Haemorhous mexicanus*) – a species that is abundant in both desert and urban areas – captured at six sites across an urban gradient. We captured birds in live traps in their natural environments and recorded breath rate, which has been shown to be an indicator of stress during handling. Finches were then allowed to acclimate to a cage at the field site where captured and then approached by a person. The cage was equipped with a hide area, a feeder, and an escape route out of the cage. We recorded behavioral responses (e.g. activity, time spent on feeder, time spent hiding) for 154 birds. Urban birds showed fewer nervous behaviors than rural birds and had higher activity scores than suburban birds, which could correspond with higher parasite load found at suburban sites. In the hand, urban birds also showed a lower breath rate than rural birds. Finally, urban birds were better problem-solvers, as it related to locating the escape route in the cage. Taken together, these results provide support for the idea that urban birds show a reduced stress response when faced with human-induced challenges.

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Weller, N.[1], D. L. Childers[1], and L. Turnbull[2]. *Impact of Plant Community Changes on Nutrient Retention within an Aridland Constructed Wastewater Treatment Wetland.

In this study, we examined how community composition varies over seasons in a constructed wetland system (CWS) and how this variation influenced nitrogen retention. We quantified intra-annual plant community composition changes within a 21ha CWS at a wastewater treatment facility in Phoenix, AZ. Every 2 months, beginning in July 2011, we measured plants within 5 randomly placed 0.25m^2 quadrats along ten 50-m transects for characteristics found to be significant in species-specific allometric models that relate various plant characteristics to dry weight. Water samples were taken at the inflow and outflow, filtered, and analyzed for total dissolved nitrogen content. Aboveground plant tissue samples were collected, dried, milled, and analyzed for carbon and nitrogen content.

We observed little change in aboveground peak biomass composition from July 2011 to July 2012. During these two months *Typha domingensis* and *Typha latifolia* composed most aboveground biomass (66%). *Schoenoplectus americanus* showed the highest aboveground nitrogen content levels for above and below ground biomass (2.14% and 1.35% dry weight, respectively). *Typha* spp. showed the lowest nitrogen content in aboveground biomass (1.34% dry weight); however, due to its high biomass density, proved the most efficient plant at retaining nitrogen per unit area (average N g/m^2 at peak biomass). From March 2012 to May 2012, *Typha* spp. accounted for the majority (1502 N kg) of total aboveground macrophyte N retention (2319 N kg). Overall, macrophyte N retention accounted for 6% of total N input. Other factors (e.g., denitrification, sedimentation) must account for the majority of N retention within the system.

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Wyant, K. A., Y. M. Marusenko, S. J. Hall, and J. L. Sabo. *Dynamics of Urban Biogeochemical Cycling Coupled with the Interactions Between Soil Microbial Communities, the Belowground Food Web, and Land-Use Type in an Arid Ecosystem.

Previous research shows that regular application of water and fertilizers (N and P) in mesic, turfgrass lawns modifies soil microbial community structure, distribution, and

function, which alters N cycling pathways. It is unclear how land-use modifications affect belowground microflora and fauna in urban areas which regulate urban biogeochemistry and soil function. In this study, we ask: 1) Who are the major groups of soil flora and fauna in an urban belowground ecosystem and how do populations change during the dry and monsoon seasons? and, 2) How do landscape types affect the interactions between biota, soil properties, and nutrient cycling? For 2011 and 2012, we collected a series of 108 soil cores during the dry and monsoon seasons in metro Phoenix. Soils were processed for flora and fauna, quantification of N cycle metrics, and molecular analyses. As expected, mesic lawns harbor increased soil moisture over two seasons (dry and monsoon) relative to xeric and native desert sites. However, mesic lawns support different microarthropod communities, including increased abundances of predatory and fungal feeding mites. N dynamics were also affected by land-use, N fertilization and season. For example, N cycling rates were elevated in native compared to native+N, and total inorganic N was higher after the monsoon. Preliminary sequencing shows diverse archaeal ammonia oxidizers in native and native+N deserts. This research will innovate urban biogeochemistry research by coupling organismal activity at different scales of the soil community with observations of N cycling patterns across a mosaic of human dominated landscapes.

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Important Upcoming CAP LTER Dates:

February 1, 2013 Deadline

Call for Proposals: 2012-2013 Grad Grants for Research in Urban Ecology and Urban Systems Research

In 2012-13, CAP LTER is continuing its Grad Grants program in support of graduate student research. Grad Grants will be awarded on a competitive basis to graduate students conducting research within the CAP LTER study area on some aspect of urban research. These projects do not necessarily have to be part of current CAP LTER research activities, but priority will be given to work that compliments and potentially enhances ongoing CAP research or that uses LTER data resources or sites. Spring 2012 awardees are not eligible for this competition.

March 10, 2013 Deadlines (RFP's will be released in early February, 2013)

1. Call for Proposals: Research Experience for Undergraduates (REU)

CAP LTER receives funding every year to support Research Experience for Undergraduates (REU) as part of its core funding from the National Science Foundation. CAP researchers are invited to submit REU proposals for either summer 2013 or the 2013-2014 academic year.

CAP's REU program is structured to be a learning experience for undergraduate students to work with CAP senior scientists. REU students take responsibility for the research project and are expected to produce a research poster and possibly to co-author a paper within a year of completing their experience. While REU students enhance the productivity of research projects within CAP LTER, they are not to be viewed as labor for these endeavors. Faculty members are responsible for identifying their own REU students, preferably before submitting a proposal for REU support. Although students can certainly assist in writing a REU proposal, we intend that this proposal come from a CAP faculty member.

2. Call for Proposals: Graduate Summer Research Assistance

CAP LTER is asking senior scientists to submit requests for funding Summer 2013 graduate research assistance for work on senior scientist-led research projects related to CAP LTER's objectives and theme. This is different from the funding provided through the CAP Grad Grants program for graduate student-led research. Unlike traditional funding for RAs, funding for graduate research assistance does not pay tuition remission during the summer. Instead, graduate students will be paid on an hourly basis. Graduate students hired for Summer 2013 can be supported for up to 20 hours per week for up to six pay periods (12 weeks) for total summer pay up to $6000. Faculty requests should include the desired wage rate for the graduate student who will be hired.

3. Call for Proposals: Faculty Summer Salary

CAP LTER faculty may request summer salary of up to $5000 to support work on CAP-related research. This can include support for research, manuscript preparation, or other research-related activities. Faculty receiving summer salary will need to arrange for this addition to their summer contracts with their own units.

September 26-27, 2013 - NSF mid-term site visit

For additional information contact Michelle Wolfe at michelle.wolfe@asu.edu or Marcia Nation at Marcia.nation@asu.edu.