22nd Annual

CAP LTER All Scientists Meeting and Poster Symposium

Friday, January 17, 2020

SkySong

ASU Julie Ann Wrigley Global Institute of Sustainability
Arizona State University

LTER

NSF

CAP LTER Twenty-Second All Scientists Meeting
and Poster Symposium
January 17, 2020
Synergy I and II, Building 3
Skysong, Scottsdale, Arizona

8:00 a.m. Poster setup.

8:30 a.m. Registration, coffee and tea

9:00 a.m. **State of the Program Address & CAP Service Awards**
Dan Childers, Director, CAP LTER and Professor, School of Sustainability

9:15 a.m. **Keynote Presentation**
Margaret Palmer, Director, National Socio-Environmental Synthesis Center (SESYNC), Annapolis, MD

10:15 a.m. **BREAK**

10:30 a.m. **Interdisciplinary Research Theme (IRT) Updates #1**

Adapting to City Life – Paige Warren
Residential Landscapes and Neighborhoods – Sharon Hall
Scenarios and Futures – Marta Berbes Blazquez, Elizabeth Cook, Nancy Grimm, and David Iwaniec
Parks and Rivers – Heather Bateman and Amber Wutich

11:15 a.m. **Poster Session #1 – Graduate Students**

12:30 p.m. **Lunch**

1:30 p.m. **Interdisciplinary Research Theme Updates #2**

Climate and Heat – David Hondula
Urban Design – Paul Coseo
Water and Fluxes – Becky Ball
Governance and Institutions – Abigail York and Dave White

2:15 p.m. **Interdisciplinary Research Theme Meetings – #1**

3:00 p.m. **BREAK**

3:15 p.m. **Interdisciplinary Research Theme Meetings – #2**

4:00 p.m. **Poster Session #2 – Undergraduates, Faculty, and Other Community Members**

5:00 p.m. **Closing Statement / Announcements**

5:15 p.m. **Adjourn, CAPpy Hour at Bitters**

2020 CAP LTER Poster Symposium

Posters are listed alphabetically by first author with poster location number in parentheses. *Indicates a graduate student poster and **undergraduate student poster.

Poster Session #1	Poster Session #2
*Allen et al. (1)	**Citrin et al. (2)
*Andrade et al. (3)	**Coleman et al. (4)
*Brown et al. (5)	**Faust et al. (6)
*Buchanan and McCluney (7)	*Fleeger et al. (8)
*Cheng et al. (9)	**Hernandez et al. (10)
*Clark and Johnson (11)	**Kempf et al (12)
*Dwyer and Lewis (13)	*Lindley and Johnson (14)
*Elser et al. (15)	*Ortiz and Ball (16)
*Godwyll and Quay (17)	**Rosales et al. (18)
*Haight et al. (19)	**Torres and Ball (20)
*Helmrich et al. (21)	Berbés-Blázquez et al. (22)
*Lauck and Grimm (23)	Earl (38)
*Lebeiko et al. (25)	Funk et al. (24)
*Li and Wang (27)	Hartnett and Sauer (28)
*Nguyen and Westerhoff (29)	Iwaniec et al. (26)
*Olhert et al. (31)	Kim et al. (28)
*Polekoff et al. (33)	Lewis et al. (30)
*Shrestha et al. (35)	Raschke et al. (40)
*Smith et al. (37)	Reichmann and Russell (42)
*Stuhlmacher et al. (39)	Sampson et al. (32)
*Venkatesh et al. (41)	Vanos et al. (34)
*Wang et al. (43)	York et al. (36)
*Webb and McGraw (44)	Grade et al. (48)
*Wheeler et al. (45)	
*Wright et al. (46)	
*Yazar et al. (47)	

Keynote Speaker Bio

Margaret A. Palmer is a Distinguished University Professor at the University of Maryland, College Park, and Director of the National Socio-Environmental Synthesis Center (SESYNC). Her research has focused on coastal and freshwater ecosystems with an emphasis on restoration of rivers, streams, and wetlands. She is an international leader in restoration ecology, has >175 peer-reviewed articles and led the 2nd Edition of the *Foundations of Restoration Ecology*, a widely used text. She and colleague J. David Allan organized the first national synthesis of river and stream restoration in the U.S. that amassed a database with ~40,000 projects. Palmer serves on numerous scientific advisory and editorial boards including the Board of Reviewing Editors for *Science* magazine and the Water Sciences & Technology Board of the National Academies of Science. She is a fellow of: AAAS, the Ecological Society of America (ESA), Lilly Scholars Program, and Society of Freshwater Science (SFS). Among her awards are the: SFS Award of Excellence, ESA Sustainability Science Award, Ruth Patrick Award from the Assoc. for the Sciences of Limnology & Oceanography, Ramon Margalef Lecturer Award (Portugal), and Hynes Lecturer Award (Canada). She has been an invited speaker in numerous and diverse settings including regional and international forums, science-diplomacy venues (e.g., in North Korea), and popular outlets such as the Steven Colbert show. Palmer is also known for her work at the interface of science, policy, and law and has provided expert testimony to congress, in federal court, and to numerous regional entities.

Team Research on Socio-Environmental Problems: Why is it so damn hard?

All environmental problems are social problems. Finding solutions to these require research collaborations that span boundaries between the natural and social sciences. For the last eight years, the National Socio-Environmental Synthesis Center (SESYNC) has been supporting synthesis team research to both grow such collaborative communities and produce actionable findings. In this talk, I will describe: what is meant by socio-environmental synthesis and why it differs from other forms of synthesis; provide examples of projects SESYNC has supported; and discuss some of the lessons we have learned including ways to accelerate successful socio-environmental team research.

List of Posters

***Indicates graduate student poster and ** indicates undergraduate student poster.**

ADAPTING TO CITY LIFE

Allen, Brittany D., Heather L. Bateman, Marianne S. Moore, and David M. Hondula. *Urban heat island effect and rodent body condition.

***Brown, Jeffrey A., Anthony Basile, Heather Bateman, Susannah Lerman, Paige Warren, and Karen Sweazea. *No fry zones: Birds' responses to restaurant distributions in the Phoenix metropolitan area*.**

***Buchanan, Jacob D., and Kevin E. McCluney. *Spatial synchrony of ground beetle communities in Phoenix, AZ*.**

Clark, Ryan C., and James C. Johnson. *Using animal behavior to understand the impact of urbanization: Do urban black widows behave differently from their desert counterparts in the field or lab?

***Dwyer, Jessie M., and Jesse S. Lewis. *Bat habitat use across the gradient of urbanization in a single season*.**

****Faust, Ryan, Jeffrey Haight, and Jesse S. Lewis. *The effects of urbanization on scorpion populations, reproduction, and predation in the Phoenix Valley, Arizona.***

****Fleeger, Melissa, Kelli L. Larson, Megan M. Wheeler, Riley Andrade, Jeff A. Brown, Susannah B. Lerman, Sharon J. Hall, and Desiree L. Narango. *Who is abuzz about bees? Explaining residents' attitudes in Phoenix, Arizona.***

Funk, Alexander, Pierce Hutton, Stevan R. Earl, Pierre Deviche, and Karen L. Sweazea. *Effects of urbanization on morphology and nutritional physiology of Gambel's Quail*, Callipepla gambelii.

Grade, Aaron M., Paige S. Warren, and Susannah B. Lerman. *Do human-provided resources mediate effects of temperature on bird abundances in residential neighborhoods?

***Haight, Jeffrey D., Sharon J. Hall, and Jesse S. Lewis. *Species richness of mammals and terrestrial birds across a gradient of urbanization in central Arizona*.**

****Lindley, Sarah E., and James C. Johnson. *The effect of food availability on black widow spider success at UHI temperatures.***

Reichmann, Ann, and Steven Russell. *ASU Project Cities*.

****Rosales, Jenna, Jennifer K. Vanos, David M. Hondula, Mary Wright, Stephen Elser, Alyssa Henning, Manuel Herrera, and Nicole Cox. *Heat and sun exposure along active transport pedestrian pathways.***

***Smith, Jordan P., Sara Meerow, and B. L. Turner II. *Suitable for growth: Siting urban gardens through multicriteria decision analysis*.**

Stuhlmacher, Michelle, Stevan Earl, and Lance Watkins. *Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

Vanos, Jennifer K., Chingwen Cheng, Scott Cloutier, Paul Coseo, Brian Grant, Aaron Hess, Alison Ross, and Jianni Labato. *Microscale urban adaptations to mitigate heat and air pollution exposures and improve children's health: An overview*.

***Webb, Emily A., and Kevin J. McGraw. *Variation in carotenoid profiles as a reflection of life history strategy in urban house finches*.**

***Wright, Mary K., Peter J. Crank, Ariane Middel, David M. Hondula, and David J. Sailor. *A comprehensive assessment of the thermal environment of two PASS neighborhoods*.**

CLIMATE AND HEAT

Allen, Brittany D., Heather L. Bateman, Marianne S. Moore, and David M. Hondula. *Urban heat island effect and rodent body condition.

***Elser, Stephen R., Nancy B. Grimm, and Ariane Middel. *Growing shade: How common tree species in Phoenix vary in their cooling ecosystem services*.**

Godwyll, Josephine, and Ray Quay. *Analyzing heat and land use change for Phoenix region: 1985 to 2010.

Lebeiko, Lara, Paul Coseo, Ariane Middel, Jennifer Vanos, David Hondula, Braden Kay, Florian Schneider, Saud Alkhaled, Ananth Udupa, Jianni Labato, Liza Kurtz, Abdullah Aldakheelallah, and Julia Marturano. *Adapting urban infrastructure for local and global climate change: Climate action planning for extreme heat in urban environments.

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Stuhlmacher, Michelle, Stevan Earl, and Lance Watkins. *Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

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***Wang, Zhaocheng, Enrique R. Vivoni, and Theodore J. Bohn. *Modeling urban irrigation impact on land surface temperature in central Arizona*.**

***Wright, Mary K., Peter J. Crank, Ariane Middel, David M. Hondula, and David J. Sailor. *A comprehensive assessment of the thermal environment of two PASS neighborhoods*.**

***Yazir, Mahir, Georgios Kyriakopoulos, and Abigail York. *How do heat-related illness and socio demographic dynamics predict locals' climate change beliefs? The case of Phoenix metropolitan area*.**

EDUCATION AND MANAGEMENT

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

GOVERNANCE AND INSTITUTIONS

****Citrin, Garret, Emma Laurens, and Aidan Hernandez. *Highlighting natural gas development: Examining contrasting state policies and economic development implications.***

****Coleman, Emma, Fushcia Hoover, and Sara Meerow. *Achieving equity in stormwater management; green infrastructure criteria in US cities*.**

****Hernandez, Aiden, Emma Laurens, and Garret Citrin. *Shaping oil and natural gas policy: Developing insight to the culture, politics, and economic development of the Marcellus and Utica shale region.***

****Kempf, Morgan, Elizabeth Hartley, Mahir Yazar, Brenna Crawford, and Abigail York. *ARC-NAV: Comanagement of marine mammals in Beringia*.**

Lebeiko, Lara, Paul Coseo, Ariane Middel, Jennifer Vanos, David Hondula, Braden Kay, Florian Schneider, Saud Alkhaled, Ananth Udupa, Jianni Labato, Liza Kurtz, Abdullah Aldakheelallah, and Julia Marturano.** ***Adapting urban infrastructure for local and global climate change: Climate action planning for extreme heat in urban environments.

Lewis, Jesse S., Jeffrey Haight, and Ryan Faust. ***The distribution and abundance of the scorpion community across the gradient of urbanization in the Phoenix Valley, Arizona.***

Polekoff, Sarah, Opaline Picard, and Pierre Deviche.** ***Adjusting to city life: oxidative stress in adult and juvenile urban House Finches**, Haemorhous mexicanus.**

Raschke, Aireona B., Annia Quiroz, and Kimberlie McCue. ***The Regional Open Space Strategy for Maricopa County: Developing a shared vision for natural spaces in the urban matrix.***

Reichmann, Ann, and Steven Russell. ***ASU Project Cities*****.**

Stuhlmacher, Michelle, Stevan Earl, and Lance Watkins.** ***Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

York, Abigail, Marta Berbés-Blázquez, Mahir Yazir, and Vanya Bisht. ***Conceptualizing governance feedback mechanism in the contexts of long-term socioecological research in the US.***

PARKS AND RIVERS

Allen, Brittany D., Heather L. Bateman, Marianne S. Moore, and David M. Hondula.** ***Urban heat island effect and rodent body condition.

Brown, Jeffrey A., Anthony Basile, Heather Bateman, Susannah Lerman, Paige Warren, and Karen Sweazea.** ***No fry zones: Birds' responses to restaurant distributions in the Phoenix metropolitan area**.**

Dwyer, Jessie M., and Jesse S. Lewis.** ***Bat habitat use across the gradient of urbanization in a single season**.**

****Fleeger, Melissa, Kelli L. Larson, Megan M. Wheeler, Riley Andrade, Jeff A. Brown, Susannah B. Lerman, Sharon J. Hall, and Desiree L. Narango.** ***Who is abuzz about bees? Explaining residents' attitudes in Phoenix, Arizona.***

***Lauck, Marina, and Nancy B. Grimm. *Effects of variable inundation patterns on wetland plant communities and nitrogen uptake in the Salt River wetlands*.**

Lewis, Jesse S., Jeffrey Haight, and Ryan Faust. *The distribution and abundance of the scorpion community across the gradient of urbanization in the Phoenix Valley, Arizona.*

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Reichmann, Ann, and Steven Russell. *ASU Project Cities*.

Stuhlmacher, Michelle, Stevan Earl, and Lance Watkins. *Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

RESIDENTIAL LANDSCAPES AND NEIGHBORHOODS

Andrade, Riley, Heather L. Bateman, Cheyenne Herzog, and Kelli L. Larson. *Who rescues birds and why?

***Brown, Jeffrey A., Anthony Basile, Heather Bateman, Susannah Lerman, Paige Warren, and Karen Sweazea. *No fry zones: Birds' responses to restaurant distributions in the Phoenix metropolitan area*.**

***Buchanan, Jacob D., and Kevin E. McCluney. *Spatial synchrony of ground beetle communities in Phoenix, AZ*.**

****Fleeger, Melissa, Kelli L. Larson, Megan M. Wheeler, Riley Andrade, Jeff A. Brown, Susannah B. Lerman, Sharon J. Hall, and Desiree L. Narango. *Who is abuzz about bees? Explaining residents' attitudes in Phoenix, Arizona.***

Grade, Aaron M., Paige S. Warren, and Susannah B. Lerman. *Do human-provided resources mediate effects of temperature on bird abundances in residential neighborhoods?

Reichmann, Ann, and Steven Russell. *ASU Project Cities*.

***Smith, Jordan P., Sara Meerow, and B. L. Turner II. *Suitable for growth: Siting urban gardens through multicriteria decision analysis*.**

Stuhlmacher, Michelle, Stevan Earl, and Lance Watkins. *Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

***Wang, Zhaocheng, Enrique R. Vivoni, and Theodore J. Bohn. *Modeling urban irrigation impact on land surface temperature in central Arizona*.**

Wheeler, Megan M., Kelli L. Larson, Elizabeth M. Cook, and Sharon J. Hall. *Change over time in managed residential vegetation: Resident actions promote dynamic plant communities.

***Wright, Mary K., Peter J. Crank, Ariane Middel, David M. Hondula, and David J. Sailor. *A comprehensive assessment of the thermal environment of two PASS neighborhoods*.**

SCENARIOS AND FUTURES

Berbés-Blázquez, Marta, Nancy B. Grimm, Yeowon Kim, Paul Coseo, Elizabeth Cook, and David M. Iwaniec. *Tell me what you want, what you really, really want: Comparing practitioner-identified strategies before, during, and after scenario workshops.*

Iwaniec, David, Elizabeth Cook, Marta Berbés-Blázquez, and Nancy Grimm. T*he co-production of Sustainable Future Scenarios.*

Kim, Yeowon, Nancy B. Grimm, and Isabel Seigler. *Comparative urban futures for flood resilience: From the past failures to future scenarios.*

Reichmann, Ann, and Steven Russell. *ASU Project Cities*.

Sampson, David Arthur, Giuseppe Mascaro, Ross Maciejewski, Rimjhim Aggarwal, Dave White, Chi Duan, Xin Guan, Adil Mounir, Adenike Opejin, J. Leah Jones, Mayuri Roy Choudhury, and Yuxin Ma. *A coupled food-energy-water model for the Phoenix AMA.*

Stuhlmacher, Michelle, Stevan Earl, and Lance Watkins. *Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

URBAN DESIGN

Berbés-Blázquez, Marta, Nancy B. Grimm, Yeowon Kim, Paul Coseo, Elizabeth Cook, and David M. Iwaniec. *Tell me what you want, what you really, really want: Comparing practitioner-identified strategies before, during, and after scenario workshops.*

Cheng, Chingwen, Amanda Trakas, Paul J. Coseo, and Kristian Kelley. *Designing green infrastructure for a desert city: Design experiment of hydro-ecological

performance evaluation for biodetention details at Flood Control District of Maricopa County, Phoenix, Arizona.

***Elser, Stephen R., Nancy B. Grimm, and Ariane Middel. *Growing shade: How common tree species in Phoenix vary in their cooling ecosystem services*.**

Godwyll, Josephine, and Ray Quay. *Analyzing heat and land use change for Phoenix region: 1985 to 2010.

***Helmrich, Alysha M., Mikhail V. Chester, Samuel A. Markolf, Samantha Hayes, Cheryl Desha, and Nancy B. Grimm. *Using biomimicry to support resilient infrastructure design*.**

Kim, Yeowon, Nancy B. Grimm, and Isabel Seigler. *Comparative urban futures for flood resilience: From the past failures to future scenarios.*

Lebeiko, Lara, Paul Coseo, Ariane Middel, Jennifer Vanos, David Hondula, Braden Kay, Florian Schneider, Saud Alkhaled, Ananth Udupa, Jianni Labato, Liza Kurtz, Abdullah Aldakheelallah, and Julia Marturano. *Adapting urban infrastructure for local and global climate change: Climate action planning for extreme heat in urban environments.

Reichmann, Ann, and Steven Russell. *ASU Project Cities*.

****Rosales, Jenna, Jennifer K. Vanos, David M. Hondula, Mary Wright, Stephen Elser, Alyssa Henning, Manuel Herrera, and Nicole Cox. *Heat and sun exposure along active transport pedestrian pathways.***

Shrestha, Ashish, Alysha M. Helmrich, Margaret Garcia, Mikhail V. Chester, Eck Doerry, and Joseph Eppinger. *Exploring citizen science as a novel data source to improve urban flood modeling.

***Smith, Jordan P., Sara Meerow, and B.L. Turner II. *Suitable for growth: Siting urban gardens through multicriteria decision analysis*.**

Stuhlmacher, Michelle, Stevan Earl, and Lance Watkins. *Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

Vanos, Jennifer K., Chingwen Cheng, Scott Cloutier, Paul Coseo, Brian Grant, Aaron Hess, Alison Ross, and Jianni Labato. *Microscale urban adaptations to mitigate heat and air pollution exposures and improve children's health: An overview*.

WATER AND FLUXES

Hartnett, Hilairy and Elinor Sauer. *High temporal resolution chemistry data for Tempe Town Lake*.

***Lauck, Marina, and Nancy B. Grimm. *Effects of variable inundation patterns on wetland plant communities and nitrogen uptake in the Salt River wetlands*.**

***Li, P., and Z.-H. Wang. *A nonequilibrium thermodynamic approach for surface energy balance closure*.**

***Nguyen, Thuy, and Paul Westerhoff. *De facto reuse impacts on drinking water quality at small public water systems in the United States*.**

Ohlert, Timothy J., Mariah T. Patton, and Scott L. Collins. *Preliminary findings of drought-induced changes in ecosystem processes across U.S. deserts.

****Ortiz, Guillermo J., and Becky A. Ball. *Understanding the effects of urbanization in Phoenix, AZ on Sonoran Desert lichen population and community composition.***

Reichmann, Ann, and Steven Russell. *ASU Project Cities*.

Shrestha, Ashish, Helmrich, Alysha M., Garcia, Margaret, Chester, Mikhail V., Doerry, Eck, Eppinger, Joseph. *Exploring citizen science as a novel data source to improve urban flood modeling.

Stuhlmacher, Michelle, Stevan Earl, and Lance Watkins. *Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

****Torres, Alexander J., and Becky A. Ball. *Soil respiration under decomposing cacti in the Sonoran Desert*.**

***Venkatesh, Krishishvar, Shahnawaz Sinha. Chao Zeng, and Paul Westerhoff. *Validate the RSSCT approach to field pilot-scale adsorption columns for PFAS removal*.**

***Wang, Zhaocheng, Enrique R. Vivoni, and Theodore J. Bohn. *Modeling urban irrigation impact on land surface temperature in central Arizona*.**

Abstracts

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

Allen, B. D.[1], H. L. Bateman[1], M. S. Moore[1], and D. M. Hondula[2]. *Urban heat island effect and rodent body condition.

Increasing temperatures due to human -caused climate change may decrease their ability to survive extreme summer temperatures. Human-made surfaces and structures increase radiant heat exchange in urban areas by several degrees hotter compared to non-urban areas. Research has investigated how urbanization and heat affect human health; however, studies have not investigated the response of wildlife to urban heat. We examined the effect of Urban Heat Island (UHI) on wildlife, by evaluating animal body condition of rodents living in three different levels of heat. Animal body condition is storage of resources such as fat, which are important for survival and reproduction. We used accurate and noninvasive technology to quantitatively measure body fat, lean mass, and water content of rodents using a quantitative resonance machine. We tested the hypothesis that percent body fat, lean mass, and water content vary across three levels of temperature based upon mean daily summer temperature (i.e., 47.0-49.0 °C, 50.0-52.0 °C, and 53.0-55.0 °C). We captured 37 nocturnal rodents (Merriam's kangaroo rats, *Dipodomys merriami* and pocket mice, *Chaetodipus* spp.) using baited Sherman live traps from mid-July to mid-August in urban parks and open spaces. Our preliminary results show pocket mice and Merriam's kangaroo rats captured from cooler temperatures had more fat than rodents captured from hotter ranges. Preliminary findings will be further investigated this summer by sampling additional animals and expanding predictor variables to include vegetation cover, soil type, and land use/land cover. Our results will contribute to understanding the effects of extreme heat on urban wildlife body condition and health.

[1]College of Integrative Sciences and Arts, Arizona State University, 7271 E Sonoran Arroyo Mall, Mesa, AZ 85212-6415; and [2]School of Geographical Sciences and Urban Planning, Arizona State University, PO Box 875302, Tempe, AZ 85287-5302

Andrade, R.[1], H. L. Bateman[2], C. Herzog[2], and K. L. Larson[1,3]. *Who rescues birds and why?

Vertebrate animals are regularly brought into rescue and rehabilitation centers worldwide. Conservation groups and ecologists have acknowledged the untapped potential of rescue databases to inform management of threatened species. However, not all "rescues" are warranted and some species or individuals are more likely to be brought into a rehab center than others. This suggests that the human drivers underlying wildlife rescues are also interesting to consider. However, the scholarly literature has primarily focused on understanding the ecological drivers and implications of wildlife rescues. There has been less consideration of the attitudinal and social drivers that motivate a person's decision to rescue a particular animal they perceive as

needing help. Our study investigates the social and ecological drivers of bird rescues using census, social survey, and bird intake data collected from the Phoenix metropolitan area in 2017-2018. We found that higher income and pro-ecological worldviews were related to bird intakes, perhaps reflecting a perceived control or responsibility over nature. Conversely, identifying as Hispanic/Latinx, which relates to feeling more interdependent with nature, was negatively associated to rescue occurrence. Ecological drivers of rescues included species commonality and body size. Additionally, people were more likely to bring altricial species (which are born without feathers) into the rehabilitation center, linking to perceptions of young animals as vulnerable. Our findings are relevant to understanding drivers of human-wildlife interactions and for intake centers who wish to reduce the occurrence of people bringing in wildlife that do not actually need to be rescued.

[1]School of Geographical Sciences and Urban Planning, Arizona State University, PO Box 875302, Tempe, AZ 85287-5302; [2]College of Letters and Science, Arizona State University, 6073 S. Backus Mall, Mesa, AZ 85212; and [3]School of Sustainability, Arizona State University, PO Box 875502, Tempe, AZ 85287-5502

Berbés-Blázquez, M.[1], N. B. Grimm[2], Y. Kim[2,3], P. Coseo[4], E. Cook[5], and D. M. Iwaniec[6]. *Tell me what you want, what you really, really want: Comparing practitioner-identified strategies before, during, and after scenario workshops.*

Scenarios reveal the visions, hopes and desires of citizens. We conducted scenario workshops in south Phoenix to envision positive futures for this traditionally underrepresented area. During the participatory scenario workshop, participants built five distinct visions for the future of their community around the themes of transportation, heat resilience, flood resilience, equity district, and green gentrification. As part of this process, participants identified dozens of specific strategies to build a more desirable future that might go from increasing greenspace to changing governance structures. The strategies that were incorporated into the scenario visions came from different sources and were modified and recombined through the scenario process. First, the workshop took inspiration from strategies identified in the city's governance documents. Second, we surveyed practitioners prior to the workshop. Third, during the scenario workshops, participants selected favorites, added new ones, and discarded other ones. Finally, participants ranked strategies in a follow-up workshop using a Q-sort methodology. This poster compares how the prioritization of strategies changed before, during, and after the scenarios workshop and explores what participants felt was more doable, transformative, and suitable to fulfill their visions for a better future.

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Brown, J.[1], A. Basile[2], H. Bateman[1], S. Lerman[3], P. Warren[4], and K. Sweazea[2,5].** ***No fry zones: Birds' response to restaurant distributions in the Phoenix metropolitan area.

Urbanization provides challenges for many species by transforming natural landscapes and reducing habitat suitability. However, urbanization also provides opportunities for wildlife species that can use built structures for shelter, benefit from the displacement of predatory species, or utilize anthropogenic food sources. While it is largely accepted that species use anthropogenic food sources, it is less clear which food sources species use and how these food sources influence community composition throughout cities. Here we investigate one source of anthropogenic food, restaurants and their associated food waste, to see whether the distribution of restaurants impacts bird communities in the Phoenix, AZ metropolitan area. We assess bird communities using bird census data from 2000-2017 from CAP LTER, and compare this to land-use land-cover data as well as restaurant distribution information from business registration records from the Maricopa Association of Governments. We tested how restaurant abundance is related to species abundance while accounting for other landscape level variables. Of the 138 species documented in the CAP LTER study region, 7 show a significant positive relationship with restaurant abundance. These include European starling, rock pigeon, Eurasian collared dove, house sparrow, mourning dove, and northern mockingbird. These birds are widely distributed across cities suggesting that anthropogenic food sources likely contribute to biotic homogenization in urban settings. Additionally, some species showed a stronger relationship with restaurant abundance during the non-breeding season (winter) suggesting that restaurants may play a role in providing stable year-round food sources. These results imply a connection between bird communities and restaurant-provided anthropogenic food resources and needs further investigation.

[1]Julie Ann Wrigley Global Institute of Sustainability, Arizona State University, PO Box 875402, Tempe, AZ 85287-5402; [2]School of Life Sciences, Arizona State University, PO Box 874501, Tempe, AZ 85287-4501; [3]USDA Forest Service, Northern Research Station, Amherst, MA 01003-9285; [4]Department of Environmental Conservation, University of Massachusetts, 160 Holdsworth Way, Amherst, MA 01003; and [5]College of Health Solutions, Arizona State University, Health North Building, Ste 501, 550 N 3rd St, Phoenix, AZ 85004

Buchanan, J. D., and K. E. McCluney.** ***Spatial synchrony of ground beetle communities in Phoenix, AZ.

Spatial synchrony is a measure of how spatially separated populations of organisms may fluctuate in phase through time. Fluctuations may occur at varying timescales either intra- or interannually depending upon the drivers responsible. Synchrony is thought to be driven by correlated environmental variables (Moran effects), dispersal, and predator-prey interactions. Urban landscapes feature a myriad of microhabitats, allowing for geographically disjointed populations to exist under similar environmental conditions based on similar land management practices. There remains much to be known about the implications of spatial synchrony on important ecosystem parameters such as species abundance, richness, and stability. We used the existing CAP LTER pitfall trap data to examine the spatial synchrony of ground beetles at 24 sites across Phoenix, AZ over nine years. Spatial synchrony was determined using a variant of the

ncLISA package in R. We also examined possible correlations of synchrony with rainfall and with percent impervious surface.

Life Sciences Building, Bowling Green State University, Bowling Green, OH, 43403

Cheng, C., A. Trakas, P. J. Coseo, and K. Kelley.** ***Designing green infrastructure for a desert city: Design experiment of hydro-ecological performance evaluation for biodetention details at Flood Control District of Maricopa County, Phoenix, Arizona.

Green infrastructure design used for stormwater control has been studied extensively in areas with high frequency of storm events in the US such as Seattle, Portland, and Baltimore, but little research has been done in arid environment. The past five years, a network of cities in the Phoenix metro area have published one toolkit and one design manual for low impact development promoting green stormwater infrastructure design. This poster will present to what extent the stormwater design strategies meet Phoenix's standards in managing stormwater on site. In addition, what are the effects of climate, plants, soil, and landscape architecture details on designing for stormwater control in arid environments? The Hydro-GI Lab collaborated with CAP LTER, ASU, and Flood Control District of Maricopa County on two projects to monitor and evaluate hydrological performance of green infrastructure in Tempe and Phoenix. This poster focuses on the field design experiments installed and conducted at Durango Campus of Flood Control District of Maricopa County. Three repeated samples of three different stormwater biodetention basin design details with identical planting design were examined with: a) no soil amendment, b) with 4 inches of mulch, c) with 16 inches of amended soils. The preliminary results show promising trends of increased infiltration rates and stormwater holding capacity with additional soil amendment and increased biomass with native plants. The findings help to inform urban design and policy-making to allow alternative sustainable stormwater design using nature-based solutions in hot arid regions.

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****Citrin, G., E. Laurens, and A. Hernandez.** ***Highlighting natural gas development: Examining contrasting state policies and economic development implications.***

Over the past decade natural gas development on the Utica and Marcellus shale has increased substantially. Despite major growth in the industry nationwide, the federal government does little to regulate fracking leaving it up to individual states to pass legislation. The states in the Appalachian region, Ohio, West Virginia and Pennsylvania, have taken different approaches to regulating the natural gas industry. As an area with vast historic oil and gas development, the Appalachian region serves as an interesting case study when attempting to quantify the regional economic impacts of the hydraulic fracturing industry. While social scientists rarely use raw satellite data from remote sensing imagery, we couple this imagery with labor statistics data to determine 1) if remote sensing imagery serves as a valid proxy for regional economic development in

regions with little data and 2) how competing policy approaches in the Appalachian region impact aforementioned economic development. Given the different policy approaches taken, we posit that states that allocate taxation funding to municipalities will experience greater spatial economic development and spillovers when compared to states that limit or withhold funding from municipalities. As natural gas becomes a more prominent source of energy, comparing state approaches to industry regulation can provide a basis for adopting or abandoning strategies that encourage regional economic development.

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Clark, R. C.[1], and J. C. Johnson[2]. *Using animal behavior to understand the impact of urbanization: Do urban black widows behave differently from their desert counterparts in the field or lab?

Urbanization often leads to a modification in species diversity throughout the world, extirpating many taxa from large sections of their natural range. Be that as it may, there are a handful of species that thrive in these novel ecosystems. Animal behavior is just one facet of phenotype that may be explaining why some thrive in this environment where others fail to exist. In this research we look at a few behavioral differences between individuals of a species found in both urbanized and undisturbed Sonoran Desert near central Arizona. Here, we followed 22 individuals in the adult phase of the cobweb producing spider, the North American Western Black Widow, *Latrodectus hesperus*. Previous work has demonstrated this species to be highly diverged genetically between these relatively close habitats and more cannibalistic in the desert setting. Our study aims to uncover what role the habitat of origin (urban vs. desert) has on the individual expression of foraging boldness, antipredator boldness and voracity. Our earlier investigation documented and showed no significant behavioral differences in the field. Out in the field there is a myriad of complicating variables such as temperature, diet, and disturbance regimen. We hypothesize that once assayed in the lab under standard conditions the behavioral differences will be uncomplicated by this environmental noise. We predict that desert black widow spiders will be bolder when foraging, bolder under predation disturbance and more voracious toward prey.

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****Coleman, E.[1], F. Hoover[2], and S. Meerow[3]. *Achieving equity in stormwater management; green infrastructure criteria in US cities*.**

Urban green infrastructure (GI) must be planned and sited like other element of the built environment, and inevitably requires negotiating conflicting priorities. Yet when it comes to planning GI, there seems to be a gap between theory and practice. GI is widely promoted on the basis of its multifunctionality (e.g., ecosystem services), and planning guidance emphasizes the importance of factoring multiple benefits into siting decisions. But in practice, decisions about where to site green infrastructure are often

opportunistic or based on one or a few benefits, rather than strategically sited to maximize the full range of desired functions. As many of these services – or disservices– are highly localized; residents in the neighborhoods where GI gets developed are disproportionately impacted, making GI an environmental justice issue. Planning decisions are further complicated by the historical or cultural relationships between vegetation and residents, and the lack of investment in marginalized communities across the country. In this paper, we examined planning documents across 25 US cities and identified the rationale cities specify for siting and prioritizing placement of green infrastructure, the benefits or ecosystem services most often cited, and the data used as part of this process. Based on preliminary results, we hypothesize that while cities have established goals and a strong intent for multifunctional planning of GI that includes social, economic, and community benefits, there is a lack of explicit and clear steps to achieving these goals, and little to no mention of metrics or data to be used in the process.

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***Dwyer, J. M., and J. S. Lewis. *Bat habitat use across the gradient of urbanization in a single season*.**

Urbanization influences the distribution of bats, a diverse group of mammals that plays important ecological roles, such as pollinators, seed dispersers, and predators of night-flying insects. The response of bats to urbanization is species-specific, with some bats being more sensitive to urbanization than others. Bats can be categorized into urban avoiders, urban adapters, and urban exploiters based on their distribution across a gradient of urban intensity. Urban avoiders reach their highest relative density, or relative use, in wildland areas, urban adapters peak in relative use at moderate levels of urbanization, and urban exploiters reach their highest relative use in highly urban areas. Little is known about bat distribution along urban gradients, especially in understudied regions, such as arid environments. The goal of this research is to understand the effect of urbanization on bat habitat use in an arid region. To achieve this, we deployed acoustic bat monitors at 50 sites across the Phoenix metropolitan area in locations with varying levels of urbanization, from non-urban wildland habitat to highly urban cityscape. We surveyed each site for 5 nights, or 5 occasions, during the summer season of 2019. We then manually identified 34,000 bat echolocation calls using the SonoBat species identification software and created capture histories consisting of detection/non-detection data for each species. We will use this data to evaluate bat habitat use across the gradient of urbanization in the summer season using single-season, single-species occupancy modeling. We expect bat habitat use to vary, consistent with the urban avoider, urban adapter, and urban exploiter framework. Our findings will reveal which bat species are most sensitive to urbanization, and therefore most in need of long-term monitoring and targeted management as the Phoenix metropolitan area continues to expand.

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

The CAP LTER addresses the challenges of curating and disseminating research data with a robust Information Management System (IMS) that benefits CAP LTER investigators and the broader scientific community. The CAP LTER IMS facilitates the ingestion of research data and metadata from the project's long-term monitoring programs and project investigators. CAP LTER data are archived with the Environmental Data Initiative, which provides long-term storage and access to research data. Research data are also cataloged by the DataONE federation, which greatly enhances their discoverability. Through these resources, data from the CAP LTER's long-term monitoring programs and project investigators are available to the community as building blocks for future research efforts. For project investigators, submitting data through the CAP LTER meets the data publishing requirements set by funders and publishers, and each data set is given a citation with a Digital Object Identifier (DOI) that a data provider may reference. The CAP LTER Information Manager and the GIOS Informatics Team are available to assist with the data publishing process, data management plans, and generally to provide guidance regarding effective approaches to managing research data.

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

***Elser, S. R.[1], N. B. Grimm[1], and A. Middel[2]. *Growing shade: Daytime cooling ecosystem services of common street trees in Phoenix*.**

Extreme heat is one of the chief environmental and public health concerns for the City of Phoenix. In 2018 alone, 182 people died from heat related ailments in Maricopa County. To help address heat concerns, in 2010 the City of Phoenix published a Tree and Shade Master Plan with the goal to achieve 25% canopy cover by 2030. While more than doubling current tree canopy cover would assuredly provide many ecosystem services including heat mitigation, the plan offers no details on what tree species to plant. Trees differ in their form and function, so it is important to understand how those differences manifest themselves in terms of ecosystem service provision. We ask: how do nine common trees species in Phoenix vary in terms of the cooling ecosystem services that they provide? In the summer of 2019, we walked transects through three Phoenix neighborhoods at three different times of day (morning, around noon, and the late afternoon), collecting measurements underneath individual trees and exposed reference locations with a mobile human-biometeorological station (MaRTy). Here, we focus on mean radiant temperature (TMRT), an important metric for understanding human thermal comfort. We found that tree species did not explain differences in TMRT, but tree size and shade from surrounding built infrastructure (e.g., walls and buildings) better explained site level differences in cooling. Our findings suggest that the sampled tree species have similar cooling performance, which means that when planting new trees, local decision makers should consider other services and disservices, such as air purification, pollen, and maintenance costs.

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Faust, R.[1], J. Haight[2], and J. S. Lewis[1]. *The effects of urbanization on scorpion populations, reproduction, and predation in the Phoenix Valley, Arizona.*

Urbanization can substantially affect populations and communities for a variety of flora and fauna. Little information is known, however, about how the scorpion community changes across the gradient of urbanization in the Phoenix Valley, Arizona. Across the gradient of urbanization, the objectives of this project were to evaluate: (1) how the scorpion community changed, (2) the proportion of scorpions that exhibited reproduction, and (3) the prey items captured by scorpions. Across the Phoenix Valley, we focused on four species, including bark, stripe tailed, giant desert hairy, and yellow scorpions. We conducted walking transects using UV black lights, where we visited 50 locations three times each during the summer of 2019. Consistent with predictions, the scorpion community changed across the gradient of urbanization. Stripe tailed and giant desert hairy scorpions were observed mostly in wildland and low density urbanization areas, indicating they were relatively sensitive to higher levels of urbanization. Whereas, bark scorpions were the only species observed in heavily urbanized areas. In addition, bark scorpions were observed with offspring and with prey across the gradient of urbanization. Common prey items of scorpions included beetles, moths, flies, cock roaches, and other scorpions. This study can be used to understand the effects of urbanization on scorpion communities and their life history.

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Fleeger, M.[1], K. L. Larson[2], M. M. Wheeler[3], R. Andrade[2], J. A. Brown[4], S. B. Lerman[5], S. J. Hall[3], and D. L. Narango[6]. *Who is abuzz about bees? Explaining residents' attitudes in Phoenix, Arizona*.

Bees provide essential ecosystem services by pollinating crops and increasing biodiversity. Many stressors plague bee populations including habitat fragmentation and degradation, pathogens, and pesticide exposure. With bee communities at risk, conservation efforts are imperative, yet few studies have analyzed variation in human attitudes toward and perceptions of bees, or how these perspectives might influence bee conservation in cities. We analyzed residents' attitudes toward and perceptions of bees in metropolitan Phoenix, Arizona. Specifically, we ask: 1) What cognitive, environmental, and social factors explain whether people like or dislike bees? and 2) How do attitudes and perceptions about bees relate to land management practices, specifically landscaping choices, herbicide and pesticide use, and desert plantings? Overall, attitudes toward bees were mostly neutral with a slight trend toward dislike but most residents did not believe bees were problematic at their homes. Additional findings revealed that risk perceptions, ecological worldviews, and pet ownership significantly explained attitudes toward bees. Moreover, people who live closer to desert parks had relatively positive attitudes toward bees. Regarding yard management practices, both

attitudes toward and perceptions of bees were positively correlated with adding desert plants to residential yards, and people who used pesticides had more negative attitudes toward bees. Our results indicate conservation potential for urban bee populations, for example, by planting native vegetation in residential areas near desert preserves. We hope this study will result in more attitudinal research on bee species and other understudied urban wildlife.

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Funk, A.[1], P. Hutton[1], S.R. Earl[2], P. Deviche[1], and K.L. Sweazea*[1,3]. *Effects of urbanization on morphology and nutritional physiology of Gambel's Quail,* Callipepla gambelii.

Gambel's Quail, *Callipepla gambelii*, are gregarious birds commonly found in the southwestern deserts of the United States and northwestern Mexico. With expanding urbanization, these birds are often found in exurban and suburban areas where they have access to food sources that may differ from those used by birds living in rural-urban fringes. To investigate this, we compared the morphology and nutritional physiology of quail sampled at sites varying with respect to land use and cover. We hypothesized that quail living in urbanized areas have access to a greater variety of food sources and to more stable food resources, and so are in better body condition, than quail residing in less urbanized areas. We sampled adult birds at locations in the greater Phoenix, Arizona (USA) metropolitan area that vary with respect to land use and cover types. Birds were weighed and their body length as well as chest circumference were recorded. We collected a blood sample from the jugular vein of each individual for analysis of plasma total proteins, triglycerides, and free glycerol using commercially available kits. Consistent with the hypothesis, birds living in more urbanized environments were longer and had higher circulating lipid concentrations than birds living in less developed areas, suggesting greater access to lipid-rich foods. In addition, we found a negative association between the areal proportion of grass and lakes and plasma free glycerol ($r=-0.46$, $p=0.031$), and a trend for a positive association between this proportion and plasma protein concentrations ($r=0.388$, $p=0.073$). These results suggest that quail living in areas with more grass have access to less dietary fats but more proteins than urban birds. These findings are the first to demonstrate an association between urbanization and the morphology and nutritional physiology of Gambel's Quail.

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Godwyll, J.[1], and R. Quay[2]. *Analyzing heat and land use change for Phoenix region: 1985 to 2010.

The urban heat island is an emerging issue for many urban areas. Recent research suggests that increased temperatures resulting from urban heat island effects of increased urbanization could be as high or higher than those resulting from climate change. The research question for this project is, what has been the relationship between increasing urbanization and urban temperatures in Phoenix for a 25-year period from 1985 to 2010. This poster will present interim results for this research. Utilizing CAPLTER Landsat based land cover classifications for the Phoenix region for six periods from 1985 to 2010, an analysis of land cover change was conducted. Utilizing CAPLTER temperature data sets for the same period, a heat change maps will be developed. Relationships between land cover change and heat change will be assessed.

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Grade, A.M.[1]*, P.S. Warren[2], S. B. Lerman[3]. *Do human-provided resources mediate effects of temperature on bird abundances in residential neighborhoods?*

Humans in residential areas provide a variety of resources that birds and other animals may use, such as bird feeders, pollinator gardens, and water features. These additional food and water subsidies could alter or even stabilize species compositions and abundances, especially in regions with low or seasonally fluctuating resource densities. Availability of human-provided resources, in contrast to naturally occurring resources, is often consistent across time and decoupled from environmental stressors such as temperature. We suggest that human-provided food and water in residential neighborhoods may buffer the effects of temperature for urban-dwelling birds in a desert landscape. We present here results of a pilot analysis in which we tested the interacting effects of seasonality, temperature and human-provided resource availability on abundances of three focal bird species that occupy residential neighborhoods in the Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) study system. We developed a series of species distribution models using 2015 – 2016 bird abundance data generated by Phoenix Area Social Survey (PASS) bird censuses, as well as data on food and water as self-reported by residents in the 2017 PASS survey and collected in the 2015 Ecological Survey of Central Arizona (ESCA). We predicted that if there is a resource buffer effect on a species, then there will be a greater influence of human-provided resources on species distributions in the spring than in the winter within the same neighborhood, and in neighborhoods with higher temperatures than in neighborhoods with lower temperatures. We plan to apply these methods to an additional seven species with varying life history traits, and we predict that species life history traits will influence the presence of a buffer effect. The results of this study will provide insights into how human-provided resources mediate effects of temperature and natural resource fluctuations on birds in residential neighborhoods.

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***Haight, J. D.[1], S. J. Hall[1], and J. S. Lewis[2]. *Species richness of mammals and terrestrial birds across a gradient of urbanization in central Arizona*.**

Urban ecosystems provide unique opportunities and challenges for the management of wildlife species and the services and disservices they provide. However, current wildlife management approaches in cities are often reactive, focusing on the removal of individual species when and where they are deemed to be a nuisance. Developing a more explicit, evidence-based management approach to managing urban wildlife requires knowledge of the social and ecological factors that drive the dynamics of broader wildlife communities in unique ecoregional contexts. In this research, we specifically ask how a community of mammals and terrestrial birds respond to urbanization in the desert context of Arizona's Phoenix metropolitan area. We have primarily hypothesized that the species richness of the overall wildlife community and of its component guilds would vary significantly across two key environmental gradients associated with urbanization: urban land cover and vegetation cover. To assess this variation in the wildlife community, we have maintained a randomized array of 50 camera traps across the CAP LTER study area since March 2019. We have collected and classified images by species, producing datasets containing observations of wildlife species at each camera location. Using a preliminary dataset of 14 species observed across 34 sites during April 2019, we have used multi-species occupancy modeling to evaluate how the wildlife community changes across an urbanization gradient. Preliminary results have demonstrated heterogeneity of overall and guild-level species richness at sites located across gradients of urban land cover and vegetation cover. Next steps for this research include evaluating additional social and ecological landscape characteristics that influence habitat quality for multiple species at a range of spatial and temporal scales and investigation of how patterns of wildlife diversity relate to observed patterns of human-wildlife interactions.

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Hartnett,[1,2] and E. Sauer[2]. *High temporal resolution chemistry data for Tempe Town Lake*.

Tempe Town Lake biogeochemistry changes on a variety of timescales that range from diurnal (hourly), to seasonally and inter-annually. Here we present a comparison of chemistry data obtained through long-term discrete sampling and data obtained from an automated data sonde. The sonde collects data every 30 minutes and has been in nearly continuous operation for one calendar year. The results include data for temperature, conductivity, pH, dissolved oxygen, chlorophyll fluorescence and CDOM. We compare changes in the CDOM measurements with our long-term laboratory measurement of dissolved organic carbon (DOC) and DOC fluorescence.

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Helmrich, A. M.[1], M. V. Chester[1], S. A. Markolf[1,2], S. Hayes[3], C. Desha[3], and N. B. Grimm[4]. *Using biomimicry to support resilient infrastructure design.

As the world becomes increasingly complex and uncertain, infrastructure, the systems that support the institutions and services that maintain a functioning society, must be resilient to expected and unexpected disturbances such as climate change or disruptive technology. Today, infrastructure design is commonly approached from a fail-safe method that designs infrastructure to an acceptable level of risk, and the infrastructure is considered to be in a 'fail' state if it is not providing its intended service. By not allowing for failure in design, infrastructure managers can only optimize the performance of a system based on what is known and may not consider the consequences when the unknown (re: unexpected failure) occurs; and, due to complexity and uncertainty, these unexpected failures become more frequent, leading to advocacy for resilient infrastructure. Resiliency is commonly defined by engineers as robustness, but it can be generally defined as the ability for an infrastructure system to not only to withstand predicted disturbances but continue to function beyond its design envelope. How can infrastructure managers design infrastructure to be resilient? To make this transition, infrastructure managers can examine life's principles found in biomimicry. Nature has long withstood disturbances within and beyond its designed capacity and can serve as a model for engineers. This work compares current resilient design principles to resilient infrastructure theory and utilizes life's principles to explore transitions to resilience. Current engineering design principles do not exhibit an integration of life's principles, which are more closely mirrored by resiliency principles. However, life's principles show how resiliency can be integrated into existing design practices as shown with the presented case study. The paper closes with a discussion on infrastructure design strategies that could be implemented to help fill the gaps identified.

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****Hernandez, A., E. Laurens, and G. Citrin. *Shaping oil and natural gas policy: Developing insight to the culture, politics, and economic development of the Marcellus and Utica shale region.***

Natural gas development has skyrocketed over the past decade in the northern Appalachian region. Correspondingly to the unprecedented growth rate of the natural gas industry, state legislatures have struggled to regulate the massive industry. Ohio, West Virginia, and Pennsylvania adopted different approaches to regulating the industry. The Appalachian region serves as a fascinating case study where three different legislative strategies govern both companies and communities on a singular shale. Additionally, remnants of the coal industry have left a culture of unemployment, underemployment, and poverty behind. Our goal is to assess the efficacy of the legislative approaches regulating the industry's potential negative externalities and promoting development within communities with consideration to cultural barriers. State

legislative processes are typically slow, often intransigent, while industry activity and the effects of production and development on communities sometimes changes rapidly; there is heterogeneity between communities and uncertainty in impacts. There is often a mismatch in the speed of change in the economy, communities, and industry and policy adoption at the state level. From a legislative perspective, a thorough understanding of the regional economic impacts the industry has will provide a basis for adopting or abandoning policy strategies to promote regional economic development and reduce unintended consequences. To assess the efficacy of state policies in encouraging local economic development, we conduct a content analysis of the policy documents and match that with a multi-dimensional framework analysis assessing unintended effects, equity, cost, feasibility, and acceptability indicators. Tax data coupled with household and municipal government surveys will provide additional detail regarding the policy efficacy. Preliminary sample evidence has led us to hypothesize that there is a discrepancy between the perceived development intended by key policy makers and the actual impacts felt by communities due to a varying degree of cultural beliefs. Regionally, natural gas has become an integrated part of the energy sector and driver of local economic development; evaluating the impact of regulatory and fiscal policies on perceived and actual community development spillovers is critical for the region, states, and local communities.

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Iwaniec, D.[1], E. Cook[2], M. Berbes-Blazquez[3], and N. B. Grimm[4]. *The co-production of Sustainable Future Scenarios.*

Scenarios are a tool to develop plausible, coherent visions about the future and to foster anticipatory knowledge. We present the Sustainable Future Scenarios (SFS) framework and demonstrate its application through the Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) urban site. The SFS approach emphasizes the codevelopment of positive and long-term alternative future visions. Through a collaboration of practitioner and academic stakeholders, this research integrates participatory scenario development, modeling, and qualitative scenario assessments. The SFS engagement process creates space to question the limits of what is normally considered possible, desirable, or inevitable in the face of future challenges. Comparative analyses among the future scenarios demonstrate trade-offs among regional and microscale temperature, water use, land-use change, and co-developed resilience and sustainability indices. SFS incorporates diverse perspectives in co-producing positive future visions, thereby expanding traditional future projections. The iterative, interactive process also creates opportunities to bridge science and policy by building anticipatory and systems-based decision-making and research capacity for long-term sustainability planning.

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****Kempf, M.[1], E. Hartley[1], M. Yazar[1], B. Crawford[2], and A. York[1]. *ARC-NAV: Comanagement of marine mammals in Beringia*.**

The Arctic is warming on average twice as rapidly as the rest of the planet, which is leading to significant changes in sea ice to which local communities must respond. Beringia, a region of the Arctic encompassing US and Russian territory, is expected to experience some of the highest variability in sea ice conditions in the coming century. ARC-NAV: Arctic Robust Communities-Navigating Adaptation to Variability is a new NSF funded Navigating the New Arctic (NNA) project. This poster focuses on one aspect of the larger ARC-NAV project, marine mammal comanagement. Marine mammals are an important cultural and economic resource for coastal indigenous communities engaging in mixed economies (that include marine mammal hunting in addition to participation in regional, national, and international market economies). Increasing variability of sea ice extent, reduced ice thickness, changing ice structure, and shifting timing of sea ice is affecting communities' abilities to safely harvest marine mammals. In recent decades comanagement of marine mammals in the USA has been heralded as a success, but a rapidly changing ecology due to changing sea ice temperatures, changing extent of marine mammal food sources, and sea ice change is shifting the habitats for marine mammals, affecting communities' livelihood strategies, and the long-term viability of the comanagement system. This project focuses on the question: how do we design better and more flexible governance of marine mammals to adapt to changing Arctic conditions? To answer this question, the team explores current comanagement institutions for marine mammals in Beringia, specifically examining the flexibility and intransigence of existing governance arrangements. Using existing literature, we develop a social-ecological system analysis of marine mammal comanagement in the Arctic drawing lessons from the rich literature on marine and other fisheries.

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Kim, Y.[1], N. B. Grimm[2], and I. Seigler[3]. *Comparative urban futures for flood resilience: From the past failures to future scenarios*.

As cities continue to lead urban resilience planning, exploring how cities picture their future to address flood risk in diverse socio-cultural and biophysical contexts can help us understand what strategies advance flood resilience. Urban Resilience to Extremes Sustainability Research Network (UREx SRN) has been developing participatory scenarios as one of fundamental instruments for synthesis of governance strategies and data in planning urban resilience. By evaluating potential outcomes associated with social-ecological change, participatory scenarios provide valuable knowledge on regional flood mitigation. The study investigates the flood mitigation strategies extracted from participatory scenarios of UREx cities including Baltimore, Miami, New York City, and Phoenix, and examines how the alternative futures of these cities are described by multi-stakeholders for flood resilience. In addition, the study explores the failure cases of existing mitigation solutions where the scenarios are spatially focused, and demonstrates the opportunities and barriers of adopting strategies suggested by the

scenarios. The flood mitigation strategies developed through the participatory scenarios are similar across four cities as cities understand the importance of incorporating social, ecological, and technological systems (SETS) approach in all aspects of flood resilience. However, Phoenix, being the only city not on the coast, has strategies primarily focused on short, intense rain storm by improving the drainage system, while the other cities have both heavy rain events and coastal flooding strategies. From the past failure cases, the study finds that the current infrastructure systems are somewhat inadequate adopting new resilient flood mitigation strategies. While adopting new strategies can be challenging for cities due to limited resources and knowledge, the result of this study help cities in bridging the gap between new ideas and viable adaptation solutions for future flood resilience.

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***Lauck, M., and N. B. Grimm. *Effects of variable inundation patterns on wetland plant communities and nitrogen uptake in the Salt River wetlands*.**

Green urban features provide many ecosystem services. In addition to supporting and cultural services often associated with urban green spaces, urban wetlands effectively regulate elevated nitrogen in urban runoff. However, nitrogen removal efficiency of wetlands varies. Several factors have been shown to contribute to this variation – including environmental conditions, stoichiometry, and plant diversity. While the dependence of wetland plant community composition on water availability has been established, the effect of communities on total nitrate removal is less understood. Recent work found species-specific differences in denitrification rate, nitrogen retention, and biomass accumulation that varied over time and as a function of species interactions. This suggests nitrogen removal may be dependent on complex interactions between community functional composition and environmental conditions. In this study, I ask, how do plant community interactions vary as a function of water conditions in an arid urban wetland, and how does this variation affect nitrogen uptake? I surveyed plant communities in eight accidental wetlands representing a range of inundation patterns along the Salt River over ten months. Vegetation cover data was coupled with periodic leaf tissue nutrient analysis to evaluate nitrogen removal and environmental conditions over time. Over the survey period, inundation patterns and plant community composition varied across sites over time due to variable inputs between urban drainages. Leaf tissue nitrogen content varied over time as a function of inundation both within and between species over time. This data will help inform urban water management and stream restoration decisions to maximize ecosystem benefits, while also contributing to long-term data on arid urban accident wetland ecosystems.

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Lebeiko, L.[1], P. Coseo[1], A. Middel[2], J. Vanos[3], D. Hondula[4], B. Kay[5], F. Schneider[3], S. Alkhaled[1], A. Udupa[6], J. Labato[7], L. Kurtz[8], A. Aldakheelallah[1], and J. Marturano[6]. *Adapting urban infrastructure for local and global climate change: Climate action planning for extreme heat in urban environments.

In 2019, the city of Tempe, Arizona, initiated its Health Impact Project as a pilot for reducing extreme heat along four types of infrastructure: public parks, multi-use paths, walls, and parking lots. A cross-sectional team of researchers, residents and city officials worked in four stages: 1) citywide heat and health survey to understand social differences between Tempe character areas; 2) microclimate assessments to measure surface, air, and mean radiant temperatures across various sun exposures, materials, and times of day of the four infrastructure types; 3) a participatory heat assessment conducted by residents and researchers to measure temperatures across various infrastructure, and learn how perceptions and preferences intersect with those measurements; and 4) a climate action design workshop, where researchers and city officials explored findings and began co-creating design guidelines. The findings were reviewed jointly, which aided in the fluidity of application from research to policy. First, the information format was modified to allow quicker processing of data by policy makers. Temperatures were presented in Fahrenheit, and visual heat maps were connected to a consistent scale and location map, to clarify context across findings. City leadership was able to request and obtain critical clarifications, such as a better understanding of how the time of day and site location impacted thermal comfort dynamics. Finally, the team discussed the pros and cons of the methodology and the findings, identifying areas where policy changes and future pilot programs would and would not be beneficial, allowing proactive planning and also opportunities for addressing code conflicts in federal and grant funding requirements. This pilot advances Tempe's climate action planning and will inform policy and designs of city infrastructure that will be in design process in 2020. The poster will present initial design and policy guidance developed from the summer 2019 activities.

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Lewis, J. S.[1], J. Haight[2], and R. Faust[1]. *The distribution and abundance of the scorpion community across the gradient of urbanization in the Phoenix Valley, Arizona.*

Multiple scorpion species co-occur with humans and development in the desert Southwest. However, where scorpions overlap in their distribution with humans varies spatially depending on landscape configuration. It is largely unknown how the scorpion community responds to varying levels of urbanization and landscape characteristics at finer spatial scales. The objective of this project was to evaluate how the distribution, diversity, and abundance of scorpion species varied across the Phoenix Valley in

relation to the gradient of urbanization and other landscape characteristics. During the summer of 2019, we surveyed 50 sites across the urban gradient using UV “black” lights by walking 560 m long transects three times. Results from occupancy modeling demonstrated that four scorpion species (striped-tailed, giant desert hairy, bark, and yellow) occurred in wildland and low-density urbanization areas. However, as urbanization increased, the scorpion community changed substantially and was comprised of only one species, the bark scorpion, which became hyper abundant at several high-density urbanization sites. This study provides important information about the effects of urbanization on species and community composition. In addition, our work can help identify potential human-wildlife conflict zones with the one species of scorpion that poses a threat to human health in the Phoenix Valley. Further, we provide novel information about the scorpion community that can be used for educational outreach and conservation.

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***Li, P., and Z.-H. Wang. *A nonequilibrium thermodynamic approach for surface energy balance closure*.**

The surface energy imbalance, viz. that the measured turbulent dissipation (latent heat and sensible heat) does not fully account for available energy, has for long been an outstanding challenge in geophysical studies. In this study, we developed a novel approach based on nonequilibrium thermodynamics by representing the atmospheric boundary layer as a heat engine. The engine converts the surface heat into mechanical work embedded in the turbulent motions. The efficiency and power production rate of the engine are primary determined by surface temperature and the local temperature profile. In addition, an analytically tractable approach was used to estimate the ground heat flux based on Green’s function approach, which in turn determines the available energy that drives the atmospheric heat engine. The proposed model was evaluated using heat fluxes measured by four AmeriFlux eddy covariance towers with atmospheric temperature profiles recorded at adjacent radiosonde sites. The surface energy balance closure can be improved by ~10% over various landscapes, by including the estimated power production from the atmospheric heat engine. The findings of the study identified a significant heat sink and revealed a new mechanism of surface energy transport. The proposed method is of great importance in the improvement of the climate and land surface models.

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****Lindley, S. E., and J. C. Johnson. *The effect of food availability on black widow spider success at UHI temperatures*.**

Humans make vast alterations to their environment, with an important example being the Urban Heat Island (UHI) effect. UHI is defined as an increase in temperature in urban areas due to the introduction of heat-retentive building materials and additional

heat sources. This temperature increase can have an energetically taxing effect on the organisms that try to survive in these areas. However, some organisms are able to adjust to, and even thrive under, UHI conditions. Therefore, benefits must exist in urban living which outweigh this cost. This experiment examined the effect of food availability on the success of one such organism that is able to thrive under UHI conditions, the Western black widow spider (*Latrodectus hesperus*). UHI has previously been observed to increase the developmental speed of black widow spiders. As a result, we hypothesized that high prey abundance, which is typical of urban settings, would enable spiders under these conditions (high temperature and high food) to be more successful than spiders under typically rural conditions (low temperature and low food). This was tested by placing spiders in incubators at desert and UHI temperatures, and feeding half of each temperature group 8 flies per week and the other half 16 flies per week. Molt data was recorded daily, and the mass of each spider was recorded upon conclusion of the experiment. It was found that developmental speed was greatly influenced by the interaction of food and family of origin, while mass was most greatly influenced by the single factors of food and temperature. However, the predicted interaction between food and temperature was not significant. These findings suggest that the success of spiders living under UHI conditions cannot be contributed to environmental factors alone, but also to innate genetic predisposition.

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***Nguyen, T., and P. Westerhoff. *De facto reuse impacts on drinking water quality at small public water systems in the United States*.**

De facto reuse occurs when treated wastewater is discharged into the upstream of public water system (PWSs). Municipal wastewater treatment plants (WWTPs) are sources of chemical or microbial contaminants of emerging concerns (CECs) at downstream PWS intakes. The risks of small PWSs serving communities less than 10,000 people to CECs of wastewater origin in finished drinking water may be more significant than larger PWSs, yet very little data are available to estimate de facto reuse associated with the systems. This study expanded a "De Facto Reuse in our Nations Consumable Supply (DRINCS)" model to include PWSs serving less than 10,000 people with three times more of these smaller PWSs (N ~ 6,000 drinking water intakes). The goals of the study are to: (i) estimate the level of de facto reuse at all PWS surface water intakes; and (ii) analyze the level of de facto reuse based on Strahler Stream Orders. The modeled results showed high occurrence of DFR (associated CECs) at these smaller PWSs under average flow condition with more than 50% surface water intakes impacted by treated wastewater. More of these smaller PWSs were located on low Strahler stream orders and lack advanced processes capable of removing CECs. This study fills critical data and knowledge gaps required to perform a complete national wide analysis of extent de facto reuse and be used to identify hot spots (with higher risk of) de facto reuse where monitoring programs could be performed and where infrastructure upgrades could most effectively reduce human exposures to CECs.

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Ohlert, T., M. Patton, and S. L. Collins.** ***Preliminary findings of drought-induced changes in ecosystem processes across U.S. deserts.

In the next century, increased climate variability is anticipated to increase drought frequency across the United States. Ecologists have known for years that drier ecosystems are more sensitive to drought than wetter ecosystems, suggesting that the southwestern U.S. is particularly at risk of losing ecosystem services in the face of climate change. In our experiment, we assess the drought sensitivity of the three hot deserts of North America and attempt to understand the structural dynamics that make deserts more or less sensitive to drought.

In our experiment, we reduce annual precipitation by 66% in plots at seven sites spread across three North American deserts: Chihuahuan, Mojave, and Sonoran. At Chihuahuan Desert sites located at the Sevilleta LTER in central New Mexico, treatments began in fall 2018. Treatments at the CAP LTER in the Sonoran Desert and Granite Mountains Desert Research Center in the Mojave Desert began spring 2019. At each site, we measure plant community composition and biological soil crust (crust) activity measured via chlorophyll content. After the first year of drought in the Chihuahuan Desert plant cover decreased at all three sites and species richness decreased in two of the three sites. Across the three deserts, crust activity was greater in drought plots relative to control plots despite considerably different baseline levels of crust activity in each desert. Year One of drought treatment data will be collected in the Mojave and Sonoran Deserts this spring, enabling us to parse interactions between plant growth and soil crusts that may account for positive crust response following initial short-term drought.

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****Ortiz, G. J., and B. A. Ball.** ***Understanding the effects of urbanization in Phoenix, AZ on Sonoran Desert lichen population and community composition.***

U.S air quality regulations restrict production of some air pollutants, such as photochemical VOCs and SO_2, but restrictions on nitrogen-based “NOx gasses” emitted from vehicles are far more lenient than other pollutants. Long term monitoring research has been done in the Phoenix and greater Phoenix area by CAPLTER and has found elevated levels of total nitrogen in the central region of the city versus the outlying areas. To better understand these effects of urbanization, some studies have utilized lichens as proxies of urbanization, also known as bioindicators. However, a majority of studies utilizing lichens as bioindicators are conducted in areas that harbor a wide array of lichen genera and lichen microhabitats. Thus, the purpose of this research is to understand how desert lichen in the Phoenix area have responded to urbanization by observing community composition for richness and evenness of lichen genera. Lichen community composition has been determined for the inner-city nature preserves along with the outer-city nature preserves. At each site 150 samples of percent lichen cover specified to the genera level were recorded. Results show a small difference between community composition between the inner and outer city natural reserves in that lichen communities further from the center of the city are more diverse and even. Thus, this

shows that lichen community composition shifts in a response to increased urbanization regardless of different climate regimes.

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***Polekoff, S.[1], O. Picard[2], and P. Deviche[1]. *Adjusting to city life: oxidative stress in adult and juvenile urban House Finches,* Haemorhous mexicanus.**

Urbanization is associated with a suite of stressors which may impose selection pressure on wildlife. Urban birds may experience increased oxidative stress relative to non-urban birds due to increased exposure to oxidizing agents and reduced availability of antioxidants, ultimately leading to cellular damage. How birds respond to urban stressors depends on their physiological state, which can vary as a function of age, reproductive status, and body condition. We measured oxidative stress in avian pox-infected and apparently healthy juvenile and adult urban House Finches, *Haemorhous mexicanus*. We sampled 47 birds (25 adults and 22 recently fledged juveniles) between March and June 2019 on the Arizona State University Tempe campus. We assayed blood samples for uric acid (the main byproduct of protein metabolism and the most abundant circulating antioxidant) and blood reactive oxygen metabolites (ROMs), which are reactive byproducts of oxidative damage. Plasma uric acid and ROM levels were positively correlated (rho = 0.63) and ROM levels were higher in juveniles than adults (p = 0.02). Uric acid and ROM levels did not correlate with breathing rate or health status. Juveniles may experience higher oxidative stress due to differences in metabolism or foraging ability. Our next steps are to begin sampling non-urban finches for comparison and to recapture the individuals in this study to determine whether oxidative differences disappear during the nonbreeding season, when juveniles have become fully independent. Research on this subject may help identify when birds are most vulnerable to stress and how multiple stressors affect their physiology.

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Raschke, A. B. R.[1], A. Quiroz[1], and K. McCue[2]. *The Regional Open Space Strategy for Maricopa County: Developing a shared vision for natural spaces in the urban matrix.*

Maricopa County is one of the fastest growing counties in the United States, and this represents a challenge for both local biodiversity and residents, who consistently rate the natural setting of Phoenix as one of their highest values for the city. In order to create a shared agenda for collaborative conservation action in the region, the Central Arizona Conservation Alliance (CAZCA) undertook an 18-month, in-depth stakeholder process to develop the Regional Open Space Strategy for Maricopa County (ROSS). This process involved actors from municipal and county governments, academic institutions, and nonprofits, and resulted in the identification of four primary goals for open space in the region. These include the (1) monitoring and maintenance of existing protected areas, (2) identification of key areas to be acquired for conservation and equity purposes, (3) connecting local people with natural open spaces to foster

stewardship and locate conservation champions, and (4) to continue improving collaboration and communication among regional conservation actors. The ROSS now represents a shared vision for the future of natural open spaces in Maricopa County, and is serving as the foundation for the application of the collective impact framework to environmental challenges in central Arizona.

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Reichman, A., and S. Russell. *ASU Project Cities*.

ASU Project Cities is a university-community program connecting ASU students and faculty in select academic courses with projects and sustainability needs and/or challenges of a local community partner. Over the course of a 12-24 month program cycle, students from multiple disciplines and courses research difficult problems selected by the city. At the end of each semester, students present innovative solutions, designs, recommendations, and/or strategies to city staff, which are then used by the community to make more informed decisions to move projects, planning, and community sustainability efforts forward.

Project Cities involves a broad range of ASU academic disciplines and departments including, but not limited to, sustainability, public policy, tourism, urban planning, design, landscape architecture, engineering, business, journalism, and environmental management. Through this applied “real-world” experiential-style program, students have the opportunity to influence a local community’s decision-making and planning capacity; thus, having a lasting impact on the community’s economic, social and environmental future.

Project Cities is a signature program of ASU’s Sustainable Cities Network (SCN). SCN is a boundary program, providing a vehicle for Arizona communities to share knowledge and coordinate efforts to understand and solve sustainability problems. It is designed to foster partnerships, identify best practices, provide training and information, and create a bridge between ASU’s research and front-line challenges facing local communities. This poster is an overview of SCN and the ASU Project Cities program.

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****Rosales, J.[1], M. Wright[2], S. Elser[3], A. Henning[4], M. Herrera[5], N.Cox[6], D. Hondula[2], and J. K. Vanos[7]. *Heat and sun exposure along active transport pedestrian pathways*.**

Heat and sun exposure regularly affect pedestrians utilizing active transport in Maricopa County. Ultraviolet radiation affects the epidermis (skin) and is related to skin cancer. Optimizing shade to mitigate both heat and sun exposure may be beneficial to those using pedestrian pathways for public transport in hot and sunny locations. The current study collected fine-scale micrometeorological data in high-active transport areas in Tempe and Phoenix to quantify the average heat stress conditions along the pedestrian route (~20-minute segments). We utilized a mobile weather station (MaRTy)

pulled along the walking routes to simultaneously collect air temperature, humidity, wind speed, latitude, longitude, and solar and infrared radiation. We also attached six ultraviolet dosimeters in a 3D setup, similar to the net radiometers. Data were used to calculate: (1) average heat stress conditions along the pedestrian routes; (2) average sun protection along the route; and (3) “degree minutes” of exposure for the given route, using a wet bulb globe temperature threshold of 87.9°F, multiplied by the ridership at a given bus stop.

The 20-minute transects were segmented into three portions throughout the day (morning, midday, afternoon) to simulate a non-motorized work-day commute. With this information, urban planners can determine how shade can be utilized along a route and at a bus stop to protect pedestrians from heat stress and overexposure to sunlight during peak foot traffic of the day. Further, bus stop and street shading may employ green infrastructure involving ecological processes (e.g., plants, vegetative artwork, bus stop green roofs to attract pollinators; other autotrophs to provide habitats, nutrients, and energy for organisms).

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Sampson, D. A.[1], G. Mascaro[2], R. Maciejewski[3], R. Aggarwal[4], D.D. White[1], C. Duan[3], X. Guan[2], A. Mounir[2], A. Opejin[4], J. L. Jones[1], M. R. Choudhury[4], and Y. Ma[3]. A coupled food-energy-water model for the Phoenix AMA.

The food, energy, and water (FEW) sectors (as Networked material and Energy Flows) form an interdependent system of dynamical connections that occur along with 1) Governance Networks, 2) Urban Infrastructure and Form, and 3) Socio-Economic Dynamics in the urban metabolism system. We are developing a framework (FEWsim) that incorporates a user interface (UI) to a coupled FEW model for the Phoenix Active Management area (AMA). This UI will permit the visual display of individual model inputs and outputs, and outputs from the coupled model generated through a user-defined dynamically created algorithm. The coupled model incorporates an agronomic statistical model (MPM) and two off-the-shelf programs (WEAP-MABIA and LEAP). The MPM estimates the planting area for six dominant crops, plus a generic vegetable crop, which the MABIA module of WEAP will use to estimate yield and crop water requirements. WEAP estimates, among other things, the regional water supplies and agricultural demand (using the MABIA module). Estimates of water conveyed, pumped, and treated within WEAP are passed into LEAP which calculates the energy requirements for the network. This architecture enables us to examine scenarios that include, in part, changes in the crops planted and their effect on water use, urban growth and water policy and use, and potential shifts in the energy sectors (and energy use as a result of climate-induced changes in the system) that supply the metro area. Here we present our modeling framework and a visualization tool that can be used to highlight scenario

differences and uncertainty in the nexus inputs and outputs. Our efforts support policy discourse for integrated nexus governance in the region.

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Shrestha, A.[1], A M. Helmrich[1], M. Garcia[1], M. V. Chester[1], E. Doerry[2], and J. Eppinger[2]. *Exploring citizen science as a novel data source to improve urban flood modeling.

Globally, flooding is the most costly natural hazard. The vast majority of flood risks to life and property are concentrated in our cities; yet, the observation and forecasting of streamflow and floods in the United States is mostly focused on relatively large rivers. Rarely, fine scale urban streams and washes are analyzed. With urban flood risks projected to rise with increasing extreme precipitation events and changing land use, the ability to sense, understand, and predict urban flooding is critical. Hydrological and hydraulic modeling can increase understanding and predict flood extent based on precipitation observations and forecasts if sufficient data is available for model development and testing. The current dearth of flow measurement in the urban environments preclude model calibration and validation. We aim to address this challenge by integrating road-level water depth measurements taken by cameras mounted throughout the city, flood locations as reported through citizen science, and high resolution topographic data to develop a physical-based hydrodynamic model in order to understand the nature of urban flooding and predict future flood events. We developed a coupled one-dimensional and two-dimensional, pipe and overland flow model with the Environmental Protection Agency's Storm Water Management Model for the cities of Phoenix and Flagstaff (Arizona). Here, we present our research framework, process of data assimilation, procedure to operationalize finer resolution urban flood prediction, and preliminary work on hydrodynamic models.

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***Smith, J. P., S. Meerow, and B. L. Turner II. *Suitable for growth: Siting urban gardens through multicriteria decision analysis*.**

Confronting urban environmental and societal issues requires critical consideration of urban land use. Urban agriculture, particularly in the form of urban gardens, is actively promoted as one of multiple strategies to counter some of these challenges and promote urban sustainability goals. When incorporated into the broader urban landscape, urban gardens can serve as multifunctional green infrastructure that can provide a number of social and environmental services through the co-benefits they offer. While services, such as increased access to nutritious food and community greenspace, have been studied extensively, at present, research on siting urban gardens themselves is sparse. Siting criteria commonly involve designating food deserts

or low-income communities. This study attempts to systematize urban garden site selection, presenting a new approach for strategic urban garden planning that incorporates a variety of social-environmental criteria through multicriteria decision analysis. Utilizing local stakeholder-weighted criteria, we develop a series of siting indices that represent physical and sociodemographic factors that either contribute to site suitability or represent priority locations for urban garden development. The resulting indices—a Social Setting Index, Physical Setting Index, and Comprehensive Index—are applied to an expansive inventory of vacant candidate parcels across the Phoenix metropolitan area. The results identify a substantial amount of suitable land under all three siting indices throughout the study area, with high-scoring parcels largely concentrated within the urban core. Respective siting scores diverge towards the suburbs and urban fringe. Under the Social Setting and Comprehensive indices, high scoring parcels tend to be primarily restricted to areas of high urban disparity compared to the more broadly distributed Physical Setting Index scores, potentially discounting suburban communities that may also contain aspiring gardeners. The use of “expert” stakeholders in creating the weighted criteria provide favored locations that may or may not be consistent with where current urban gardens operate successfully.

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Stuhlmacher, M.[1], S.Earl[2], and L. Watkins[1]. *Numerical summaries and raster data of vegetation indices and land surface temperature derived from remotely sensed imagery.

We present a dataset of remotely sensed variables for use by stakeholders and researchers studying central Arizona and the Phoenix metropolitan area. The dataset contains two vegetation indices—Normalized Difference Vegetation Index (NDVI) and Soil Adjusted Vegetation Index (SAVI)—and land surface temperature (LST) from remotely sensed imagery. NDVI and SAVI are calculated from the 2010, 2013, 2015, and 2017 NAIP imagery (1m resolution, summertime data collection). LST is calculated from Landsat 5 and 8 imagery (30m resolution) from cloudless days in July and August in 1985, 1990, 1995, 2000, 2005, 2010, and 2015. All images are cropped to the CAP study area boundary. Also included are tabular summaries of the mean, median, minimum, maximum, and standard deviation of the NDVI, SAVI, and LST values for the 2011 and 2017 Phoenix Area Social Survey boundaries (45 and 12 neighborhoods, respectively).

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****Torres, A. J., and B. A. Ball. *Soil respiration under decomposing cacti in the Sonoran Desert*.**

There are numerous species of cacti present in the Sonoran Desert, some of them very well studied such as *Carnegiea gigantea* (Saguaro). However, little is known about *Opuntia chlorotica* (Pancake Prickly Pear) or *Cylindropuntia acanthocarpa* (Buckhorn

Cholla) and their ecological roles in carbon cycling and decomposition. Recent work has demonstrated the rate at which these species release nutrients, carbon, and water during decomposition. Given that these two species release carbon and calcium at a similar rate, but the prickly pear contains more moisture and higher carbon content, the soil beneath would be expected to have corresponding respiration rates. To measure the respiration rate, decaying cactus segments were located at various stages of decomposition and classified based on specific characteristics. Using a LI-COR 8100 Infrared Gas Analyzer (IRGA) CO2 flux was measured from the soil directly beneath decaying cacti to determine in situ respiration rates according to decay stage, in comparison to that of bare desert soil. The soil moisture was also recorded to determine whether the water content from the cactus was one of the primary drivers of soil respiration. The analysis is ongoing. We predict that respiration rates will vary based on the stage of decomposition, and that prickly pear will generally be more nutritious for soil microbes, leading to increased soil respiration. Better ecosystem management practices can be implemented with knowledge about how these species decompose and their roles in ecosystem carbon cycling.

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Vanos, J. K.[1], C. Cheng[2], S. Cloutier[1], P. Coseo[2], B. Grant[1], A. Hess[3], A. Ross[4], and J. Labato[5]. *Microscale urban adaptations to mitigate heat and air pollution exposures and improve children's health: An overview*.

Children living in urban areas are at heightened vulnerability to the effects of extreme heat and air pollution. Exposure to these and related ambient stressors (e.g., radiation) is associated with a myriad of direct, indirect, and interactive adverse health outcomes, including hyperthermia, thermal burns, sunburns, asthma, and an increased risk of skin cancer in adulthood. Currently, little is known regarding how existing urban infrastructure and lack of vegetation within outdoor recreational playspaces affect overall child well-being and learning. Thus, minimal evidence exists to inform the effective mitigation of exposures to enhance health and support climate adaptation. A large-scale playspace re-naturalization will be occurring in the winter of 2020 at Paideia Academies, a Title I Charter School in south Phoenix. The end product will be a "Natural Play and Learning Environment" to improve ambient health, provide experiential learning, and increase food access. Numerous meteorological and air quality sensors have been monitoring "pre-intervention" ambient exposures at two sites on the campus since May 2019, and will continue to do so throughout the long-term transformations of multiple spaces. Designs have been informed by child, teacher, parent, and administrator input. We are also monitoring student use of the spaces through personal physical activity and sun exposure monitoring. Finally, we are working with the school nurse to track child illnesses and missed class time related to heat and air pollution. This poster provides an overview of these intersecting data, preliminary pre-intervention results, and future plans for the long-term health of the site. These future efforts will also

assess how the integration and examination of enhanced green infrastructure, educational opportunities, and improved human health influence social outcomes and long-term biophysical health at this school.

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***Venkatesh, K., S. Sinha. C. Zeng, and P. Westerhoff. *Validate the RSSCT approach to field pilot-scale adsorption columns for PFAS removal*.**

Perfluoroalkyl substances (PFASs) such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are a stable group of compounds which are getting lots of attention in recent years is of contaminants of great concern. However, other compounds in these wider groups of PFAS, are yet to be studied under environmentally relevant condition, as much of the data reported are adsorption in higher levels than generally found in the environment and/or primarily conducted at laboratory-scale. Therefore, there is a need to find effective and sustainable treatment options for PFASs removal under more realistic conditions.

The MobileNEWT, is testbed funded by the National Research Foundation (NSF), has primarily integrated different Nanotechnology-based water treatment modules. The study used its pilot-scale adsorption columns, to treat groundwater well in Tempe, Arizona with pH and conductivity of about 7.4 and 2 mS/cm respectively, along with reported total PFAS concentration of 140 ppt. Three (3) columns are operated in parallel on a pilot-scale level of 130 GPD each for GACs and 200 GPD for the IX resin. The Rapid Small-Scale Column Test (RSSCTs) have been used for GAC to evaluate trace organic removal, with different design parameters (constant and proportional diffusivity). With studies reporting PFAS breakthrough using RSSCTs and lack of other testing methods, there is a need to validate the appropriateness of these models under a more realistic setting (field-condition). The RSSCTs to mimic the pilot scale columns (GAC and IX resin) on the same water using different design considerations, will address this essential research needs. The RSSCT is rapid and cost-effective tool, beneficial in simultaneously comparing different adsorbents on their performance in the same groundwater. Moreover, eighteen (18) RSSCTs with lead-and-lag column setup are already conducted on six Arizona groundwater contaminated with PFAS using GACs and IX resins. Important findings of breakthrough from these studies shall also be presented.

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***Wang, Z.[1], E. R. Vivoni[1,2], and T. J. Bohn[2]. *Modeling urban irrigation impact on land surface temperature in central Arizona*.**

Rapid urbanization in the Phoenix metropolitan area has transformed this region from a small agricultural center to a major metropolis through the fastest growth rates in the U.S. To mitigate the thermal stress resulting from urbanization in an arid area, green spaces are used extensively to provide cooling capacity through shading and enhanced evapotranspiration (ET). As a result, urban irrigation is extensively applied to maintain vegetated landscaping. Reliable and comprehensive assessment of the efficacy of urban irrigation requires accurate prediction of ET and land surface temperature (LST). However, prior numerical modeling studies share limitations by using static and tabulated land surface parameters over a complex urban surface that can result in considerable errors in simulating the urban hydroclimate. In this work, we aim to improve the modeling of urban irrigation by integrating multiple remote sensing observations into an existing modeling framework. We first retrieve high-resolution surface biophysical parameters and map the spatiotemporal distribution of urban irrigation areas from multiple remote sensing products (NAIP, MODIS, and Landsat). We then infuse the retrieved parameters and irrigation maps to the Variable Infiltration Capacity (VIC) model that has been modified to account for soil evaporation and urban irrigation. We apply the model from 2008 to 2013 and evaluate its ability to simulate surface energy partitioning, irrigation water use and LST using point observations from an eddy covariance system, outdoor water use records, and remotely sensed products (GOES and MODIS), respectively, finding good agreement. We further evaluate the impacts of urban irrigation on the LST across different land use types and find strong modulation of irrigation on the urban thermal environment. Our results show the value of high-resolution remote-sensing observations for accurately representing urban irrigation and provide a foundation for investigating urban resilience under future climate and land use change scenarios in this region.

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***Webb, E. A., and K. J. McGraw. *Variation in carotenoid profiles as a reflection of life history strategy in urban house finches*.**

With the rapid expansion of cities, novel stimuli that modify spatial and temporal elements of the environment are being introduced that could support or challenge the survival and reproduction of animals. Adaptation to these novel conditions involves a trade-off between resources dedicated to reproduction and survival. We used house finches, a popular model of sexual selection, to explore how urban birds allocate their resources, measured in allocation of carotenoids, toward maintenance and long-term survival compared to reproduction across seasons and sexes. Since carotenoids can only be acquired from the diet and are used for both reproduction, as a sexual signal, and maintenance, as an antioxidant, their distribution in different tissues can represent priorities in allocation to reproductive functions and maintenance functions. We expect to find variation in carotenoid profiles of individuals that corresponds with functions of carotenoids at different life history stages. So far we have a subset of these data from

two seasons in males, and we found differences across seasons in liver and spleen carotenoids, which are two maintenance-type tissues. We believe that these results will help us better understand the impact of human actions on the function of urban ecosystems.

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Wheeler, M. M.[1], K. L. Larson[2], E. M. Cook[3], and S.J. Hall[1]. *Change over time in managed residential vegetation: Resident actions promote dynamic plant communities.

Cities are home to over half the global population and have potential to support both human well-being and conservation goals. While combined social and ecological processes are understood to shape urban ecosystems, urban areas are often considered to be static over time. For example, once land has been converted to an urban use such as a residential yard, little further change is assumed. In this work, we focus on residential yards, which compose about 40% of urban land area and are designed and maintained by numerous individual decision-makers. We ask, how has residential yard vegetation changed over the past ten years? To address this question, we conducted a paired social and ecological survey of yards in four Phoenix, AZ neighborhoods. Vegetation in about 400 front yards was inventoried in 2008 and again in 2018, and 100 of those yards were also inventoried in 2019. These 100 yards belonged to respondents to our 2018 social survey on drivers and motivations of yard management choices. 85% of survey respondents reported having made some changes to their yard since moving in. On average, yards had over 60% turnover of woody vegetation genera from 2008-2018, with very few yards having the same woody vegetation composition at both time points. Average turnover from 2018 to 2019 was much lower; many yards had low (but non-zero) turnover and a few had high turnover. These results indicate that yards are dynamic in terms of their vegetation composition, and that turnover occurs both through small, accumulating changes and through periodic large change. The finding that yard vegetation is not maintained in a static way presents an opportunity for education and conservation, whereby residents may be open to making conservation-friendly changes if they are already altering the composition of their yards.

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***Wright, M. K.[1,4], P. J. Crank[1,4], A. Middel[2,3], D. M. Hondula[1,4], and D.J. Sailor[1,4]. *A comprehensive assessment of the thermal environment of two PASS neighborhoods*.**

In establishing the intertwined linkages among temperature, residential landscape characteristics, social equity, and heat-related health and ecological outcomes in urbanized areas, researchers have repeatedly indicated the need for measurement of the entirety of the thermal environment (i.e. not just air or land surface temperature) at a

spatial scale and location applicable to urban organisms. However, limitations in technology and resources have not previously allowed for such holistic, fine-scale measurements. Thus, with assistance from a CAP Grad Grant, we used state-of-the-art biometeorological instrumentation to measure the entirety of the thermal environment within two Phoenix Area Social Survey (PASS) 2017 neighborhoods. Specifically, we conducted 1.5-mile walking traverses along sidewalks within each neighborhood simultaneously measuring all physical variables relevant to the thermal environment: air temperature, humidity, wind speed, and radiant energy flux densities (6-directional short and longwave radiation) at 2-second intervals. The traverses occurred on June 20th and 24th (one day for each neighborhood) and again on October 1st and 3rd, and measurements were taken at 12-1 pm and at 4-5 pm on each day in each neighborhood. Our main objective was to produce a dataset of the thermal environment that can be used by all interested CAP researchers. To achieve this goal, we prioritized measurement of areas nearest to PASS households and CAP bird census and ESCA sites. We have also begun investigation into two research questions concerning the intersection of the thermal environment, built environment, urban ecological infrastructure (UEI), and human outcomes: 1) How are human heat-health outcomes, demographics, and residential landscape characteristics (e.g. yard with trees, grass, swimming pool, etc.) reported in PASS 2017 related to the various components of the entirety of the thermal environment and 2) How is the entirety of the thermal environmental driven by the proportional land cover characteristics of the built environment and UEI?

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Yazir, M.[1], G. Kyriakopoulos[2], and A. York[1].** ***How do heat-related illness and socio demographic dynamics predict locals' climate change beliefs? The case of Phoenix metropolitan area.

As one of the fastest growing economies of all metropolitan areas in the US, Phoenix metropolitan area is extremely vulnerable to climate change due to its geographical location. The increasing heat levels and heat-related illness is being observed in Phoenix metropolitan area which in turn raises concerns about the future wellbeing of 4.8 million people living in the area. Given the city's increasing population and drastically changing climate, our aim is to understand the locals' perception about climate change by looking at various factors such as their experience with the heat-related illnesses, socio-demographic factors (e.g. gender, income, ethnicity), and other dynamics including political ideology, sense of place, and trust in science. In order to analyze such variables along with the climate change belief, we will be using the Phoenix Area Social Survey (n=806) which was established as part of the Central Arizona Phoenix Long-Term Ecological Research (CAP LTER) program's long-term monitoring efforts. Analyzing the aforementioned variables can better inform policy

makers and raise awareness among citizens about the socio-demographic dynamics and climate change concerns in Phoenix.

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York, A.[1], M. Berbés-Blázquez[2], M. Yazar[1], and V. Bisht[2]. *Conceptualizing governance feedback mechanism in the contexts of long-term socioecological research in the US.*

The Long-Term Ecological Research Network fundamentally is focused on change over time and understanding the dynamics within ecological systems. Beginning in the 1990s there was a shift toward incorporating “human” elements within systems most notably with the inclusion of two urban sites, Baltimore and Phoenix. Internationally, the term social has been added explicitly to some of the international work (Long Term Social Ecological Research). Most of the USA network adopted a social-ecological framework that motivated studies across the USA sites throughout the early 2000s, which led to rapid growth of social-ecological studies. The purpose of this project is to explore the studies of governance within the SES/SETS context of the LTER. We will use literature from the LTER network to set the stage. We examine the insights from across the network and focus on some notable Central Arizona Phoenix contributions to understanding governance dynamics in the urban system. A key goal is to understand the current state of the research and set an agenda to build governance research of socio-ecological-technical systems. Through this work, we highlight the opportunities for adoption of a novel governance feedbacks and dynamics approach. The LTER enables governance researchers to identify feedbacks throughout the social-ecological system via long-term data, but also provides an opportunity to unpack the formal rules, government and non-governmental actors, and local knowledge and actual practices. We make the claim that this is a frontier in SES/SETS research, but additionally within the larger governance scholarly communities; we advocate for LTER researchers pushing forward the frontier to better understand how to govern SES.

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