Welcome to the 2017 IUWC!

On behalf of the Host and Program Committees of the 2017 IUWC, welcome to San Diego! We are delighted you are able to participate in this year's IUWC meeting. In addition to the top-notch oral and poster presentations, this year we have an all-meeting special session on **Urban Wildlife: Working Together for a Wilder Future** to engage in a community discussion on how city planners, policy makers, land managers, and scientists work together to conserve and manage urban open space and wildlife. Looking forward to a great meeting!

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The 2017 International Urban Wildlife Conference

Program committee: Bob McCleery, Seth Riley, Rebecca Lewison, Nils Peterson, Chris Moorman, Jutta Burger, Liza Lehrer, David Drake, Brad Shaffer

Host committee: Seth Riley, Rebecca Lewison, Joanne Moriarty, Hans Sin, Debra Shier, Megan Jennings, Lisa Lyren, Sheila Madrak, Roland Sosa

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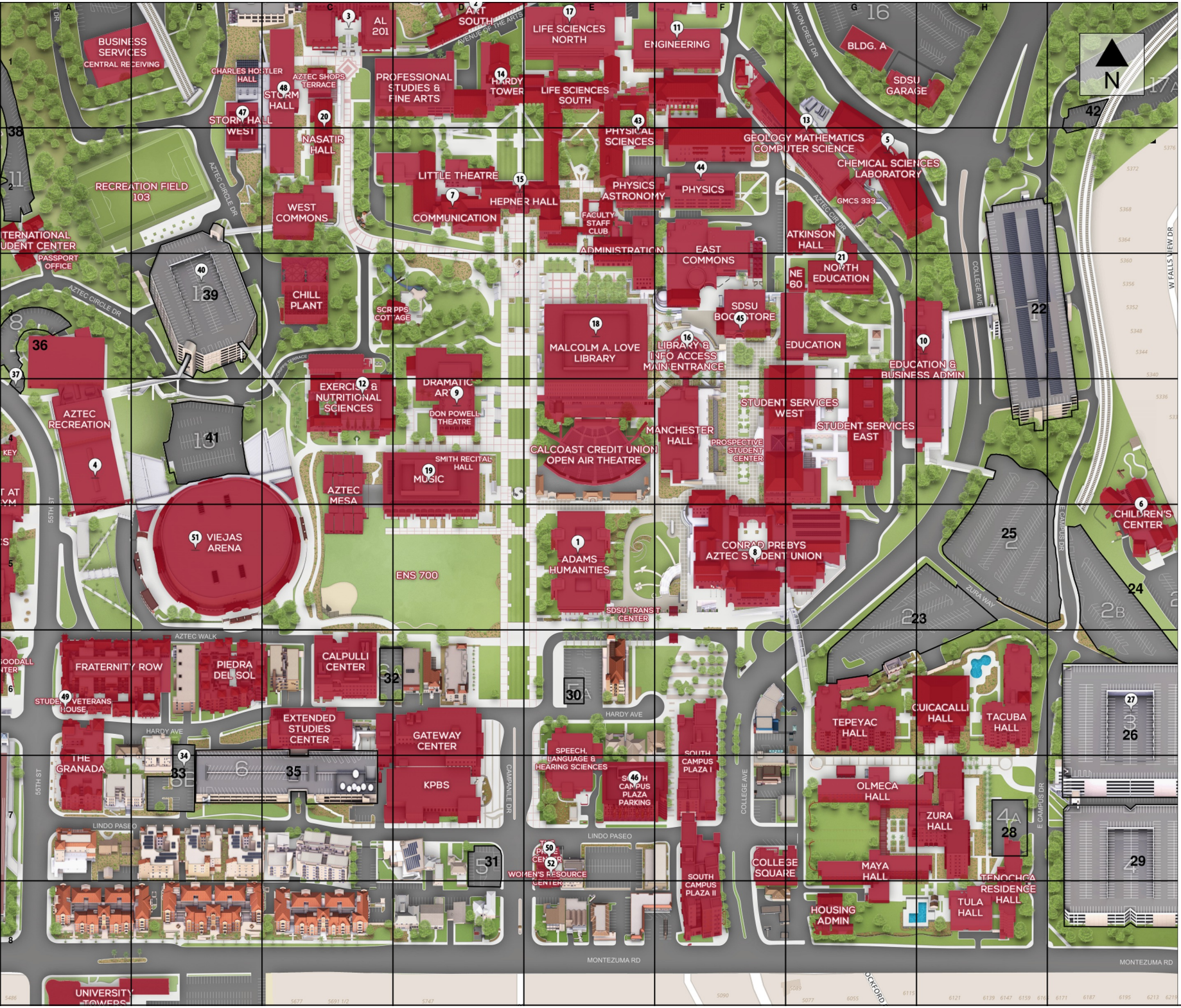
Program: Montezuma Publishing



SAN DIEGO STATE UNIVERSITY

E5	1	Adams Humanities
D1	2	Art South
C1	3	Arts & Letters
A4	4	Aztec Recreation Center
G2	5	Chemical Sciences Laboratory
I5	6	Children's Center
D2	7	Communication
F5	8	Conrad Prebys Aztec Student Union
D4	9	Dramatic Arts
H3	10	Education & Business Administration
F1	11	Engineering
C4	12	Exercise & Nutritional Science
G2	13	Geology Mathematics Computer Science
D1	14	Hardy Tower
D2	15	Hepner Hall
F3	16	Library & Info Access Main Entrance
E1	17	Life Sciences North
E3	18	Malcolm A. Love Library
D4	19	Music
C2	20	Nasatir Hall
G3	21	North Education
H3	22	PK 1
G5	23	PK 2A
I5	24	PK 2B
H5	25	PK 2
I6	26	PK 3
I6	27	PK 3
H7	28	PK 4A
I7	29	PK 4
E6	30	PK 5A
D7	31	PK 5
C6	32	PK 6A
B7	33	PK 6B
B7	34	PK 6B
C7	35	PK 6
A3	36	PK 8
A4	37	PK 8
A2	38	PK11
B3	39	PK12
B3	40	PK12
B4	41	PK13
I1	42	PK17A
E2	43	Physical Sciences
F2	44	Physics
F3	45	SDSU Bookstore
E7	46	South Campus Plaza Parking Structure
B1	47	Storm Hall West
C1	48	Storm Hall
A6	49	Student Veterans House
E7	50	The Pride Center
B5	51	Viejas Arena
E7	52	Women's Resource Center

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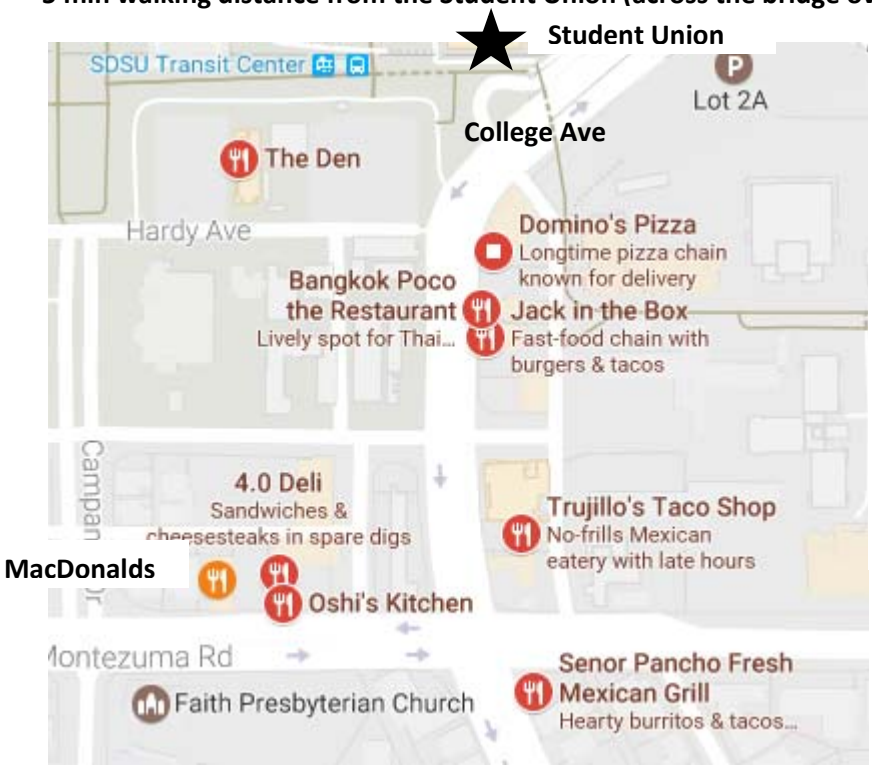
Meal options

Here you'll find a list of options for meals on campus and very close to campus. Hours of operation for campus restaurants are listed. Campus restaurants open Sunday are denoted by a **.

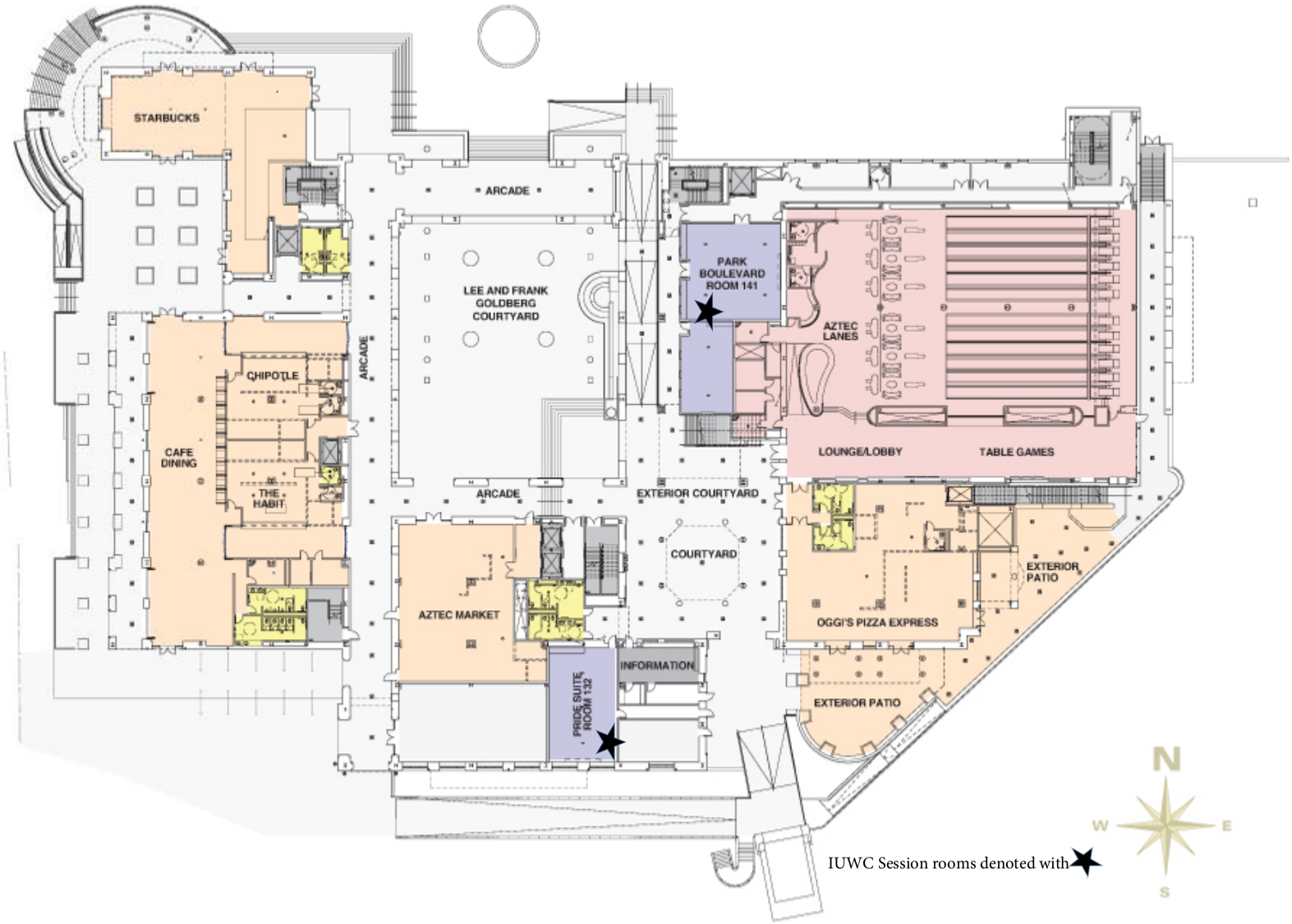
SDSU: In the Student Union
Chipotle (11am-8pm)**
Habit Burger (11am-8pm)**
Oggi's Pizza (11am-6pm)
Starbucks (630am-5pm)**
Aztec Market (7am-3pm)
Shakesmart (9am-4pm)

SDSU: East Commons, next to the SDSU Bookstore (see campus map on page 3)
Vinnie's Pizza (10am-2pm)
Rubios (8am-2pm)
Panda Express (10am-2pm)
Subway (7am-3pm)
Aztec Market (7am-4pm)
Faculty Staff Club (10am-2pm)

OFF CAMPUS:
5 min walking distance from the Student Union (across the bridge over College Ave)



- Domino's Pizza
- Jack in the Box
- The Den
- Bangkok Poco Thai
- 4.0 Deli
- Oshi's Kitchen
- McDonalds
- Starbucks
- Trujillo's Taco Shop
- Senor Pancho Fresh Mexican
- Trader Joe's - South Campus Plaza



IUWC Session rooms denoted with ★

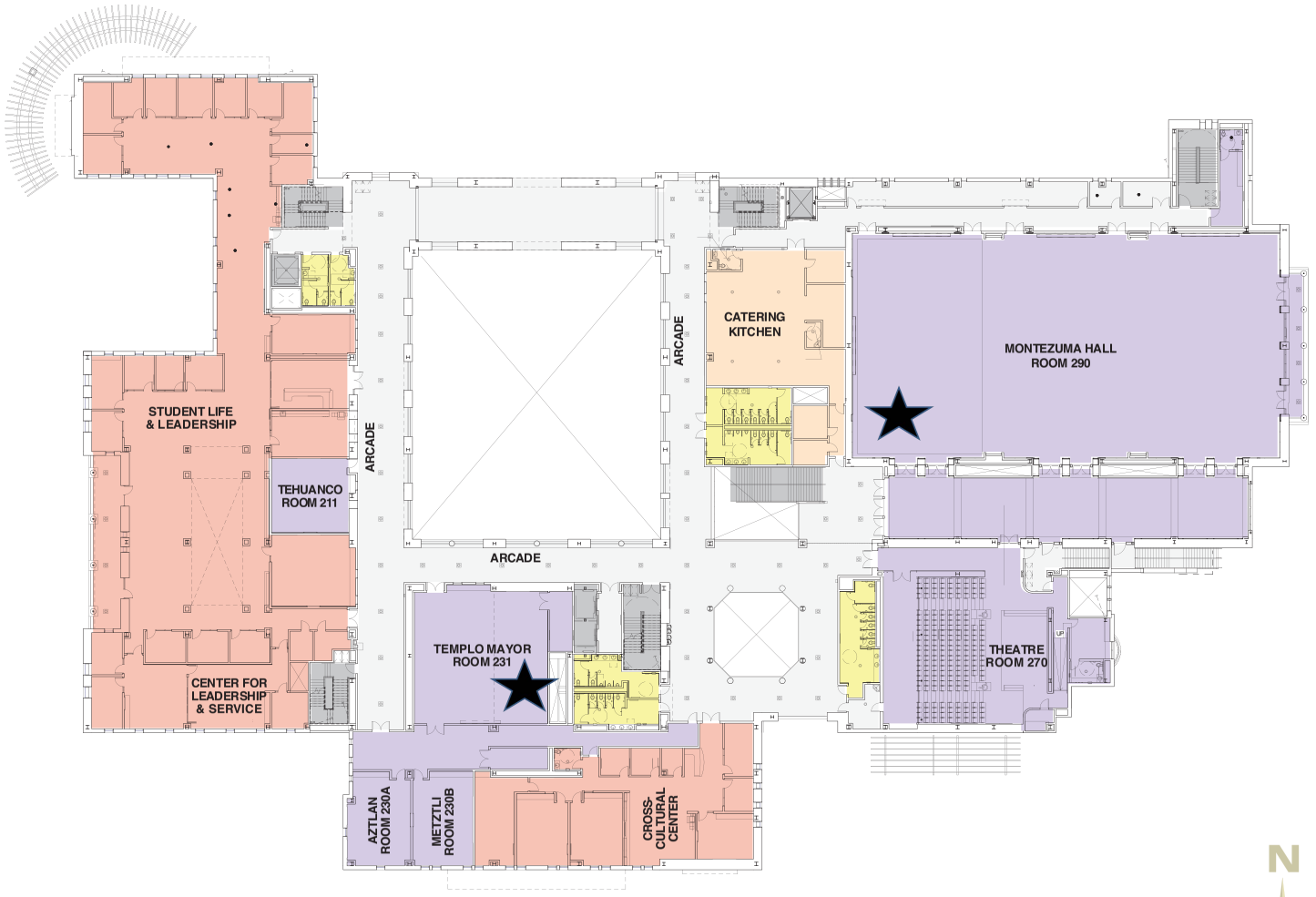
AZTEC STUDENT UNION

- Meeting Spaces
- Restrooms & Hospitality
- Bowling & Recreation
- Food & Beverage
- Associated Students

FLOOR 1

ASSOCIATED STUDENTS

SAN DIEGO STATE UNIVERSITY



IUWC rooms denoted with ★

N
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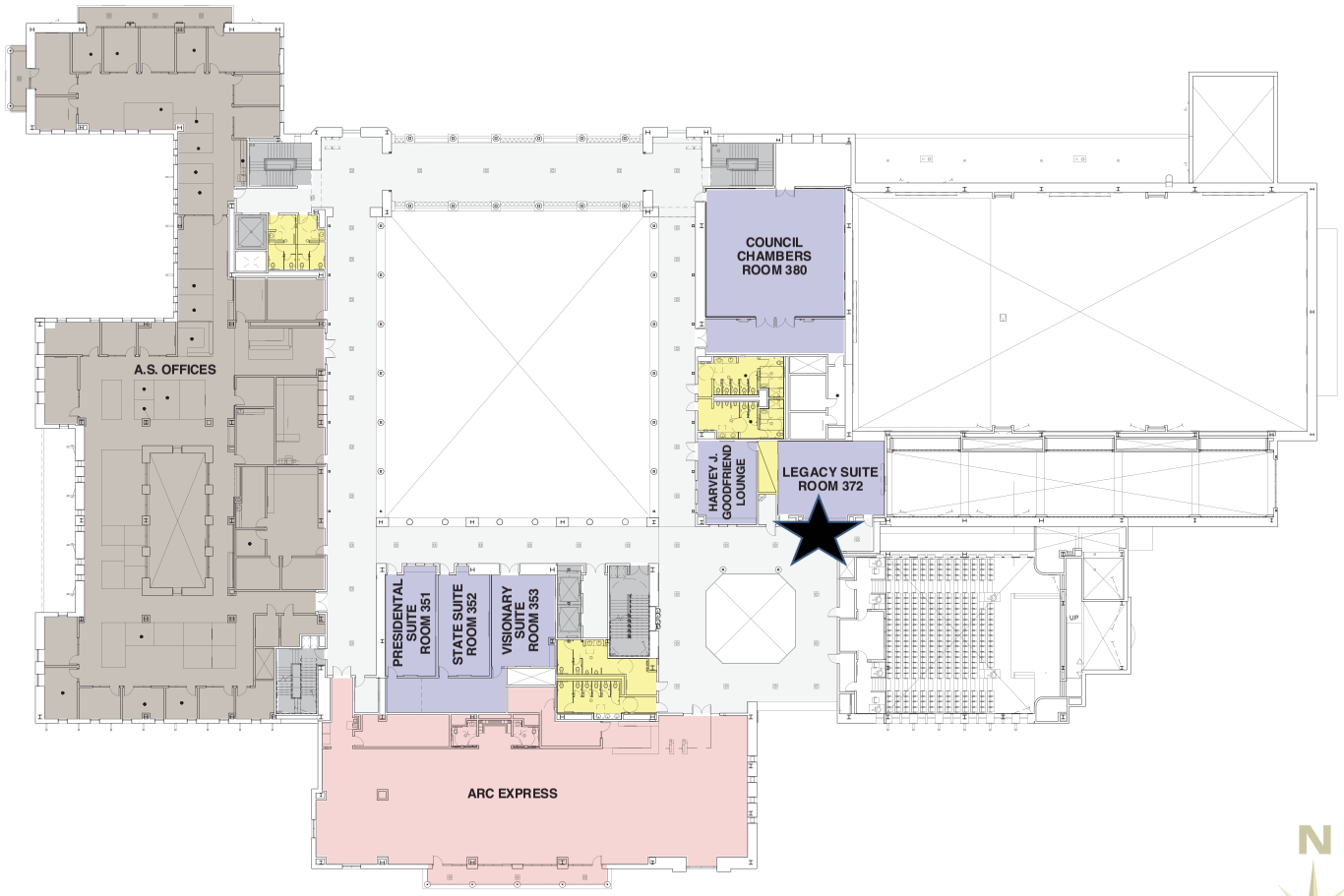
AZTEC STUDENT UNION

Meeting Spaces
Restrooms & Hospitality
Student Affiars
Catering

FLOOR 2

ASSOCIATED STUDENTS SAN DIEGO STATE UNIVERSITY

SAN DIEGO STATE UNIVERSITY



IUWC rooms denoted with ★

N
W E
S

AZTEC STUDENT UNION

- Meeting Spaces
- Restrooms & Hospitality
- Recreation
- Associated Students

FLOOR 3

ASSOCIATED STUDENTS SAN DIEGO STATE UNIVERSITY

SAN DIEGO STATE UNIVERSITY

2017 IUWC Plenary Speaker

We are delighted this year to welcome **Dr. Nancy Grimm,** Professor in the School of Life Science from Arizona State University, as our 2017 Plenary Speaker.

Dr. Grimm studies the interaction of climate variation and change, human activities, and ecosystems. Her interdisciplinary research in both urban and stream ecosystems has focused on disturbance, resilience, and biogeochemical processes. From 1997-2016 Dr. Grimm directed the Central Arizona/Phoenix Long-Term Ecological Research program, a pioneering interdisciplinary study of the Phoenix metropolitan region. She currently co-directs a Sustainability Research Network focused on urban resilience to weather-related extreme events. She was President and is a Fellow of the Ecological Society of America and is a Fellow of the American Association for the Advancement of Science. She is an editor of Earths Future, a past program director for the U.S. National Science Foundation and senior scientist for the U.S. Global Change Research Program, and a lead author for two chapters of the U.S. National Climate Assessment, released in 2014

Dr. Grimm's seminar is titled "The Rise of Urban Ecology as an Integrative, Interdisciplinary Science for the Anthropocene".

Abstract It is cliché to start an urban ecology abstract by saying that beginning in 2006, for the first time in history, more than half of the world's population lives in cities and that proportion is expected to rise to nearly 80% by the end of the century. Nevertheless, the gravity of the implications of such a major shift in world order cannot be overemphasized. Human impact on the environment, and resulting environmental changes that feed back to affect our lives, particularly in cities, is here to stay. As urban ecologists have begun to do, we need to develop new ideas and theory to set urbanization on a more sustainable trajectory. In this presentation, I will discuss the rise of urban ecology, focusing in particular on the United States after the funding of the first urban Long-Term Ecological Research (LTER) projects in Baltimore and Phoenix, which arguably was an inflection point for interest in and publications on urban ecology. I trace changes in conceptual frameworks, beginning with the ecosystem concept applied to cities, development of urban social-ecological systems theory and the press-pulse dynamics framework, to conceptualization of ecosystem services in cities, to social-ecological-technological systems (SETS) ideas. I then examine application of these ideas to the concept of disturbance, as developed by ecologists, and the problem of building resilience to the impacts of climate change. I contend that urban ecology is and must continue to be a central intellectual driver of understanding and improving cities in the Anthropocene, but that ecology looks very different from the field that spawned it.

IUWC At a Glance

Monday, June 5th

8:00 Welcome and Opening Remarks - **Montezuma Hall**

8:10 Plenary speaker: Dr. Nancy Grimm - **Montezuma Hall**

	Templo Room	**Pride Room**	**Legacy Room**	**Park Room**
9:00 - 10:40	1. Urban biodiversity	2. Wildlife soundscape in anthropogenic environments	3. Communication and education	4. Human-wildlife interactions
10:40 - 11:00	<---------- BREAK ---------->			
11:00 - 12:40	1. Urban biodiversity (cont.)	2. Wildlife soundscape in anthropogenic environments (cont.)	3. Communication and education (cont.)	4. Human-wildlife interactions (cont.)
12:40 - 2:00	LUNCH			
2:00 - 3:40	5. Challenges and opportunities managing and monitoring wildlife across conservation plans in the S. Coast Ecoregion	6. Citizen Science	8. Zoonotic diseases in urban and suburban areas/Toxicants	9. Response to altered environments
3:40 - 4:00	<---------- BREAK ---------->			
4:00 - 6:00	5. Challenges and opportunities managing and monitoring wildlife across conservation plans in the S. Coast Ecoregion (cont.)	7. Urban white-tailed deer	8. Zoonotic diseases in urban and suburban areas/Toxicants (cont.)	9. Response to altered environments (cont.)

6:00-8:00 **Poster Session - Montezuma Hall**

IUWC At a Glance

	Tuesday, June 6th			
	Templo Room	**Pride Room**	**Legacy Room**	**Park Room**
8:00 - 9:40	10. Urban coyotes	11. Ecology of wildlife diseases in urban areas	12. Planning, policy, and management for urban wildlife	13. Assessing wildlife connectivity: What can genetics tell us?
9:40 - 10:00	<---------- BREAK ---------->			
10:00 - 12:00	10. Urban coyotes (cont.)	11. Ecology of wildlife diseases in urban areas (cont.)	12. Planning, policy, and management for urban wildlife (cont.)	13. Assessing wildlife connectivity: What can genetics tell us? (cont.)
12:00 - 1:00	LUNCH			
1:00 - 5:30	14. Special session, **Montezuma Hall** **Urban Wildlife: Working Together for a Wilder Future** A participatory session to explore how the challenges of open space and wildlife conservation are being met in a variety of US metropolitan regions. Through theme- and place-based short talks, panel sessions, and audience engagement, we will examine how scientists, land managers, and city planners have worked together to conserve and manage open space and wildlife in and around cities.			

IUWC At a Glance

	Wednesday, June 7th			
	Templo Room	**Pride Room**	**Legacy Room**	**Park Room**
8:00 - 9:40	15. Ecology, behavior, and conservation of urban mammals (cont.)	16. Dysfunctional urban biodiversity planning: Take home messages for (and from) ecologists and planners/designers	17. Coastal systems and wildlife in urban areas	18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes
9:40 - 10:00	<---------- BREAK ---------->			
10:00 - 11:40	15. Ecology, behavior, and conservation of urban mammals	16. Dysfunctional urban biodiversity planning: Take home messages for (and from) ecologists and planners/designers (cont.)	17. Coastal systems and wildlife in urban areas (cont.)	18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes (cont.)
11:40 - 1:00	LUNCH			
1:00 - 2:40	19. Urban large carnivores	20. Urban partnerships that foster appreciation and conservation of wildlife	22. Ethical wildlife control	23. Invaders and survivors: Reptiles and amphibians in urban ecosystems
2:40 - 3:00		<---------- BREAK ---------->		
3:00 - 5:00	19. Urban large carnivores (cont.)	21. Roads and urban wildlife	22. Ethical wildlife control (cont.)	23. Invaders and survivors: Reptiles and amphibians in urban ecosystems (cont.)

2017 International Urban Wildlife Conference

Conference Session Program

For list of full titles, authors and abstracts, go to http://www.urban-wildlife.org/program.html

Monday - June 5th, 2017

8:00 Welcome and Opening Remarks - **Montezuma Hall**

Plenary: Montezuma Hall

8:10 **Plenary speaker**: Dr. Nancy Grimm, Arizona State University
The Rise of Urban Ecology as an Integrative, Interdisciplinary Science for the Anthropocene

1. Urban biodiversity: Templo Room

Moderator: Seth Magle

9:00	Understanding biodiversity in cities: ecological and socioeconomic filters	Charlie Nilon
9:20	If you build it will they come? Mammal diversity and metacommunity dynamics in different types of urban green space	Travis Gallo
9:40	Drivers of native bee community composition in urban landscapes	Kim Ballare
10:00	Partitioning the effects of habitat fragmentation on rodent species richness in an urban landscape	Alex Johnson
10:20	Developing a biodiversity atlas for Los Angeles County	Shenyue Jia
10:40- 11:00	***BREAK***	
11:00	Urban bat community composition along a rural to urban gradient	Ela-sita Carpenter
11:20	Determining species-specific nightly bat activity in sites with varying urban intensity	Sarah Schimpp
11:40	Measuring urban biodiversity: new web portal to support the city biodiversity index	Jennifer Rae Pierce
12:00	Introducing the urban wildlife information network: an integrated approach to urban wildlife research	Seth Magle
12:20	¡BAILA! Biodiversity assessment In Los Angeles	John M. Randall

2. Wildlife soundscape in anthropogenic environments: Pride Room

Moderator: Han Li

9:00	A synthesis of two decades of research documenting the effects of noise on wildlife	Megan F. McKenna
9:20	Effects of broadband anthropogenic noise on behavior of free-living deer mice (*Peromyscus maniculatus*)	Han Li
9:40	The chorus versus the road: the spatiotemporal constraint of anthropogenic noise and the importance of communication networks in Pacific chorus frogs	Danielle Nelson
10:00	Bioacoustics: A tool for wildlife management?	Darren Proppe

10:20	Bat species diversity and distribution in a highly urban ecosystem	Elizabeth W. Lehrer
10:40- 11:00	***BREAK***	
11:00	Threshold patterns in urbanization's effects on bat soundscape	Han Li
11:20	Using bioacoustics in a rapidly urbanizing landscape to monitor biodiversity and engage the community in sound	J. Amy Belaire
11:40	Mon Paysage Sonore: connecting urban and arctic schools through soundscapes	Karen Fisher Favret
12:00	NHMLA Backyard Bat Survey	Miguel Ordeñana

3. Communication and education : Legacy Room

Moderator: Richard Heilbrun

9:00	Raising Wildlife Awareness in New York City: Lessons, Challenges and Opportunities	Richard Simon
9:20	Texas urban wildlife program's insight to participating in the n.w.f. mayor's monarch challenge to get a city to actively support wildlife conservation from the top down	Judit Green
9:40	Our biodiversity hotspot - engaging San Diego County students with wildlife	Kimberly Kutina
10:00	An absolute game changer for wildlife conservation: What you need to know and why you should be involved	Richard Heilbrun
10:20	How to get the science out to the public and decision-makers	Joel Schulman
10:40- 11:00	***BREAK***	
11:00	All the news that's fit to print: How to get your research covered by media	Kate Kuykendall & Zach Behrens
11:20	Engaging urban communities around wildlife conservation: using storytelling to inspire action	Beth Pratt-Bergstrom
11:40	Urban elementary school garden importance	Amy Richert Goodall
12:00	Tree care for wildlife	Magen M. Shaw
12:20	Bringing birds back to Baltimore: A case study in urban conservation, education & community partnerships	Avalon Mehta Bristow

4. Human-wildlife interactions: Park Room

Moderator: Nils Peterson

9:00	Little Red Riding Hood and the shooting permission: Conflicts between humans and urban wildlife in Europe – political debate and legal management of the increasing wolf population	Judith Wachinger
9:20	How wild animals respond to human activity: Developmental processes shaping responses to anthropogenic activity in an African carnivore	Julia Greenberg
9:40	Airport Wildlife Hazard Management: DFW Airport	Cathy Boyles

10:00	Managing leopard (*Panthera pardus*) population in human modified landscape in Himalayas: - Is it possible?	S.P. Goyal
10:20	Endangered Manatees, Humans, and Crystal River National Wildlife Refuge, Florida: A Gordian Knot	Rae Ellen Syverson
10:40- 11:00	***BREAK***	
11:00	Urban Rookery Management: Texas Case Studies	Rachel Richter
11:20	The seasons and places of encounter: Analyzing human-squirrel encounters in Toronto	Tracy Timmins
11:40	Human Dimensions: Raptor-human Conflict in Urban Settings	Brian E. Washburn
12:00	What's old is new again: Cost-effective management of human-beaver conflicts	Glynnis Hood

5. Challenges and opportunities managing and monitoring wildlife across conservation plans in the S. Coast Ecoregion of SoCal: Templo Room

Moderator: Yvonne Moore

2:00	Overview of Conservation Planning in the South Coast Ecoregion and the Challenges and Opportunities for Regional Collaboration	Susan Wynn
2:20	Management and Monitoring Strategic Plan (MSP) for Conserved Lands in Western San Diego County and the MSP Portal	Yvonne Moore
2:40	Beyond NCCPs: Developing Strategies to Ensure Regional Wildlife Connectivity in Southern California	Trish Smith
3:00	Regional Occupancy and Post-fire Recovery of California Gnatcatchers in Southern California	Barbara E. Kus
3:20	Conserving Coastal Cactus Wrens: A Fragmentation Sensitive Species Facing Multiple Threats in an Urbanized Landscape	Kris L. Preston
3:40- 4:00	***BREAK***	
4:00	Biotelemetry Data for Golden Eagles (*Aquila chrysaetos*) Captured in Coastal Southern California, November 2014–February 2016	Robert N. Fisher
4:20	Recreation Management and Human Valuation, the Fusion of Social and Ecological Sciences	Milan Mitrovich
4:40	Accessibility Drives Species Exposure to Recreation in the Urbanized Coastal San Diego County Reserve Network	Courtney L. Larson
5:00	Managing Threats on Local Reserves Surrounded by the Urban Landscape	Betsy Miller
5:20	Local Efforts to Manage Shot-Hole Borer/Fusarium Complex Impacting Wildlife Due to Mass Tree Mortality	Hans Sin

6. Citizen science: Pride Room

Moderator: Chris Moorman

2:00	Parrots and People: Using Citizen Science to Conserve the Globally Endangered Red-crowned Parrot	Tony Henehan

2:20	Crowd-sourcing data collection to facilitate understanding of actual versus opportunistically observed range of urban and suburban coyotes (*Canis latrans*)	Kelly Simon
2:40	Balancing the Education & Scientific Goals of Urban Biodiversity Focused Citizen Science Projects	Lila Higgins
3:00	The otters and otter watchers of Singapore	Philip Johns

7. Urban white-tailed deer: Pride Room

Moderator: Chelby Klinghofer

4:00	Spatial genetic structure of white-tailed deer in urban landscapes: potential for localized management	Joanne Crawford
4:20	Threading the Needles: Paths to Deer Management	Scott Bates
4:40	Decision Support for Suburban Deer Management	G. Kent Webb
5:00	Using "FragPatch" to Delineate Urban Deer Habitat Patch Networks in Syracuse, New York	Chellby Kilheffer
5:20	Surgical sterilization for suburban deer management: myth or reality?	Jason Boulanger
5:40	Exploring Scale Sensitivity of White-tailed Deer Through Spatial Point Pattern Analysis.	Jacob Dillon

8. Zoonotic diseases in urban and suburban areas/Toxicants : Legacy Room

Moderator: Jennifer Murrow

2:00	Human behaviors that modify the risk of contracting zoonotic disease from wildlife: a bio-economic perspective	Graham Hickling
2:20	Host movement ecology and feeding behavior influence how resource provisioning affects infectious disease risk for wildlife	Daniel Becker
2:40	Diversity and Dilution: The Impacts of Medium-Sized Mammal Diversity on Borrelia burgdorferi Prevalence in Fragmented and Unfragmented Habitats in Connecticut, USA	Megan Linske
3:00	Challenges of managing wildlife rabies in urban environments	Jordona D. Kirby
3:20	An Integrated Tick Management Program to Reduce Risk of Lyme Disease in a Residential Endemic Area	Scott Williams
3:40- 4:00	***BREAK***	
4:00	Transmission of *Toxoplasma gondii* in Wildlife in the Southeastern US.	Richard Gerhold
4:20	Evaluation of IPM for Tick Control on School Grounds in the Northeastern United States	Erika Machtinger
4:40	Wildlife associations with emergent influenza A viruses	J. Jeffrey Root
5:00	Exposure of Wildlife to Anticoagulant Rodenticides at Santa Monica Mountains National Recreation Area: From Woodrats to Mountain Lions	Joanne Moriarty
5:20	Anticoagulant rat poisons impair immune function in a declining urban bobcat population	Laurel Serieys

9. Response to altered environments : Park Room

Moderator: Katy Delaney

2:00	Effects of urbanization on the reproductive success of grassland songbirds in San Diego County	Heather Marschalek
2:20	Nesting success of Urban and Rural Wood Thrush: Testing the Predation Paradox	Melanie Klein
2:40	Are all cities created equal? The truth is not self-evident	Chris Hensley
3:00	Effects of Artificial Light at Night on Heteromyid Rodent Foraging Behavior	Thea Wang
3:20	Drought effects on native stream breeding amphibians in Southern California	Katy Semple Delaney
3:40- 4:00	***BREAK***	
4:00	Effects of Fragmentation on the Spatial Ecology of the California Kingsnake (*Lampropeltis californiae*)	Michael Anguiano
4:20	Herpetofauna distribution patterns in the urban protected area of the Santa Monica Mountains National Recreation Area	Micah Miles
4:40	The movement behavior of the American White Ibis (*Eudocimus albus*) differs across a gradient of urbanization	Anjelika Kidd
5:00	From nomadic to hand-fed: shifts in diet and behavior in a recently urbanized wading bird	Maureen Murray

2017 International Urban Wildlife Conference

Poster Presentations

Montezuma Hall

Monday, June 6th 6:00- 8:00pm

For list of full titles, authors and abstracts, go to http://www.urban-wildlife.org/program.html

1	Sublethal Effects Of Predators On Prey Behavior And Physiology Within Urban Habitat Fragments	Carson Keller
2	The (Dark) Night-Heron Returns: Population Monitoring And Preferred Nest Height Of An Endangered Black-Crowned Night Heron Colony In Chicago, IL.	Maria Jazmin Rios
3	Effects Of Anthropogenic Disturbance On The Carnivore Community: Using Human Indices From Camera-Trapping	Laura Young
4	Wild Mammals And Their Pathogens In Los Angeles County, California	Sarah Helman
5	The Urban Biodiversity Inventory Framework	Leslie Bliss-Ketchum
7	Measuring Hair Cortisol In Urban Eastern Grey Squirrels, Eastern Cottontails, And Raccoons: Does The Level Of Urbanization Matter	Matt Mulligan
8	Puma Tracking Webmap	Brian Cohen
9	Mesopredator Occurrence In An Urban Landscape On The Southern High Plains Of Texas	Chris Carter
10	Monitoring Urban Interface Utilization By Feral Cats For Endangered Species Conservation	Austin Parker
11	Cabrillo Field Notes: Snake Encounters Of The Third Kind	Stephanie Root
12	Recent Findings On Bats Of The Point Loma Peninsula	Stephanie Root
13	Lessons From Building A 21st Century Rocky Intertidal	Alexandria Warneke
14	Evaluation Of Movements And Habitat Use Of Suburban Striped Skunks (Mephitis Mephitis) In The Northern Great Plains	Anna Schneider
15	Urbanization And Its Effects On Resource Use Of Coyotes (Canis Latrans) In Southern California	Rachel Larson
16	Urban Considerations For Ecologically Based Rodent Management	Alexis Smith
17	Ongoing Monitoring Of Small Mammals In The Urban Interface Of Kamloops, British Columbia, Canada: A Review Of 20 Years Of Data Collection	Sheri Watson
18	Microclimate Analysis Of Neotoma Bryanti Houses In The Santa Ana Wash	Brian Keyser
19	The Ecological Impacts Of Climate Change On A Biodiversity Hotspot	Amber Pairis
20	The Value Of Wildlife In An Urban World	Julianne Taylor
21	California Least Tern: The Challenges Of Conserving A Management-Dependent Endangered Species In Urban California	Nancy Frost
22	Passive Wildlife Monitoring Using Camera Traps	Alexandra Rebosura
23	Implications Of Anthropogenic Influence And Hybridization On Wild Canid Niche Characteristics	Justin Johnson
24	The Challenges Of Managing Coastal Lagoons In Urban Environments From A State Wildlife Agency Perspective	Hans Sin
25	The Relationship Between Mid-Level Disturbance And Occupancy For The Endangered Stephens Kangaroo Rat (Dipodomys Stephensi).	Denise Clark
26	A Proposed Analysis Of Deer Use Of Jumpouts Ramps And Felid Use Of Culverts Along Highways With Wildlife Exclusion Fencing.	Alex Jensen
27	Studying Stem Density, Animal Activity, Road Proximity, And Invasive Plants In NYC Forests	Emily Hargous

28	What We Have Learned From 10 Years Of Monitoring Nesting Raptors In Orange County, California	Riley Pratt
29	Monitoring Allows Adaptive Management Of Nuisance Species In Urban Environments	Max Tarjan
30	The Use Of Canine Scent Detection, Dna Testing And Other Methods To Assess The Distribution Of American Badgers In Western San Diego County	Cheryl Brehme
31	Adaptive Management Approach: Human Access And Wildlife Activity Patterns In Irvine Ranch Natural Landmarks	Courtney Aiken
32	A Web Mapping Application For Tracking Weed Abatement As A Land Management Tool	Amanda Eigner
33	A Review Of The Invasive Shot Hole Borer: The Challenges Of Managing An Invasive Beetle In Southern California.	Marcus Hubbell
34	Urban Mule Deer Translocation: Year One Update	Channing R. Howard
35	Evaluating Invasion Predictions With Physiological Data	Caitlin Mothes
36	Control possibility of corvids in urban environment - A trapping experiment	László Kövér
37	"Wildlife Rescue Bike": Innovated For Patrolling , Surveillance , Translocation & Transportation Of Wildlife	Madhurita Gupta
38	Better Than Pokémon" - Engaging The Public Through Citizen Science And Bioblitzes	Sam Kieschnick
39	Effect of Habitat Fragmentation on Snakes in Southern California Chaparral	Andrew Powers
40	Behavioral Flexibility In Captive Raccoons (Procyon Lotor)	Sarah Benson-Amram
41	Comparative Study On Pre And Post Monsoon Waterbird Diversity In Nijhum Dweep And Domar Char,Noakhali,Bangladesh	Shuvo Kumar Saha
42	A GPS Tracking Study Of Movements And Fine Scale Foraging Habitat Selection During Breeding By The Threatened Black Harrier Circus Maurus	Siamak Tavakoli
44	Wild Pig Management In Municipal Parks-Trapping And Stakeholder Engagement Case Study	Brett Johnson
45	Attributes Of Urban Environments Can Promote Increased Carnivore Community Diversity: Bakersfield, CA As A Case Study	Brian Cypher
46	The Pigeon And The Pea: What You Don't Know Can Hurt You	Cathy Boyles
47	Movement Differences And Patterns Of Space-Use Of White-Tailed Deer Among Natural And Built Environments Of Fire Island National Seashore	Chelby Kilheffer
48	Using Citizen-Science To Inform Urban Canid Management In Madison, WI	David Drake
49	Anticoagulant Rodenticides Cause Systemic Immuno-Physiologic Perturbation In Urban-Associated Bobcats (Lynx Rufus)	Devaughn Lee Fraser
50	Bats On The Bayou - Opening Doors To Urban Wildlife Planning	Diana Foss
51	How To Get People To Care About Your Research #2: Photos & Video	Kate Kuykendall
52	No Free Lunches: Foraging At The Urban Edge Leaves Caracals (Caracals Caracal) Vulnerable To Cars, Poisons, And Poachers	Laurel Serieys
53	Cities And Citizens Taking The Pledge To Help Wildlife: Re-Envisioning Our Backyards, Schoolyards, Businesses, Transportation Infrastructure And More As Wildlife Habitat And Corridors	Beth Pratt-Bergstrom
54	Use Of Molecular Tools In Understanding Crop Raiding Patterns And Patterns Of Elephant Mortality In Relation To Land Use And Urban Areas In North-West India	S.P. Goyal
56	Improving Connectivity For Mountain Lions On California Highway 17 Corridor Through Collaboration With Multiple Partners.	Tanya Diamond
57	The Importance Of The Los Angeles Urban Forest For Sustaining Migratory Bird Populations	Sevan Esaian

Tuesday - June 6th, 2017

10. Urban coyotes: Templo Room

Moderator: Justin Brown

8:00	"Wildlife Watch" A leadership response to urban wildlife conflict	Kent Smirl
8:20	Flight Initiation distance as an indicator of relative coyote boldness across an urbanization gradient	Katie Robertson
8:40	Landscape and socioeconomic predictors of urban coyote distribution: New York versus Chicago	Christopher Nagy
9:00	Engaging the Public in Urban Wildlife Research: A Case Study using Coyote and Red Fox	David Drake
9:20	Behavior and Genetic Comparisons Among Coyotes Along An Urban-Suburban Gradient.	Ashley Wurth
9:40-10:00	***BREAK***	
10:00	Movement and Activity of Coyotes in a Coastal Urban Landscape	Theodore Stankowich
10:20	Diet of coyotes in southern California at the urban-wildland interface	Paul Stapp
10:40	Movements of Coyotes From Downtown Los Angeles to Agricultural Southern California.	Justin Brown
11:00	Space Use and Interactions between red foxes and coyotes in Madison, WI	Marcus Mueller
11:20	Extreme urban ecology of coyotes in the core of Chicago, Illinois, USA.	Stanley D. Gehrt
11:40	Movements and Behavior of Eastern Coyotes in Canada's Largest City	Brent Patterson

11. Ecology of wildlife diseases in urban areas: Pride Room

Moderator: Mauren Murray

8:00	Raccoon contact networks and rabies transmission dynamics	Meggan E Craft
8:20	The Vancouver Rat Project: Understanding the relationship between rat ecology and pathogen presence in Vancouver's Downtown Eastside	Kaylee Byers
8:40	Host relatedness and urban development shape viral evolution and spread for a fragmentation-sensitive carnivore	Meggan E Craft
9:00	Disentangling the link between supplemental feeding, population density, and prevalence of pathogens with different transmission modes in urban stray cats	Jusun Hwang
9:20	Infectious diseases in urban coyotes – does land use influence pathogen exposure risk?	Cecilia A. Sánchez
9:40-10:00	***BREAK***	
10:00	Do zoos play a role in urban wildlife disease transmission networks?	Rachel E. Burns
10:20	Salmonella shedding among feral pigs, urban bird species, and waterfowl in Texas	Mary K. Grigar

10:40	Seasonal and individual predictors of grey-headed flying fox (*Pteropus poliocephalus*) foraging movements in Adelaide, South Australia and implications for disease	Cecilia A. Sánchez
11:00	Patterns of Spread of Sarcoptic Mange in an Urban Population of Endangered San Joaquin Kit Foxes: Implications for Mitigation Strategies	Brian Cypher

12. Planning, policy, and management for urban wildlife : Legacy Room

Moderator: Liza Lehrer

8:00	Using the property tax code to conserve wildlife habitat	Diana Foss
8:20	Protecting Open Space in El Paso, Texas	Lois Balin
8:40	The Mayor's Monarch Pledge – Creating Urban Monarch Butterfly Habitat in North America	Patrick Fitzgerald
9:00	Predicting success incorporating conservation subdivisions into land use planning	Christopher Moorman
9:20	Wildlife Corridors: Policy Efforts in California	Reed Addis
9:40-10:00	***BREAK***	
10:00	Multi-level Pollinator Management Plan in Municipal Parks	Brett Johnson
10:20	Successful Outcomes for Diverse Wildlife through Adaptive Management of a Restored Urban River	Lee Marlowe
10:40	Predicting Hunting Access Decisions and Hunter Density in an Urbanizing Region	Conner Burke
11:00	Green Infrastructure and Urban Biodiversity: Challenges and Strategies for Monitoring Green Spaces in Malmö, Sweden	Melissa Barton
11:20	Artificial Burrow Design and Productivity of Western Burrowing Owls in San Diego County	Colleen Wisinski

13. Assessing wildlife connectivity: What can genetics tell us? : Park Room

Moderator: Amy Vandergast

8:00	Using genetics in connectivity monitoring	Amy G. Vandergast
8:20	A single migrant enhances the genetic diversity of an inbred puma population	Kyle D. Gustafson
8:40	Using genetics to assess landscape connectivity in urbanized coastal southern California for an indicator species: Bobcat	Julia G. Smith
9:00	Spatial Scale and Structure of Genetic Relationships between Mojave Desert Tortoises (*Gopherus agassizii*) in Solar Development Zones	Kirsten Dutcher
9:20	A century of landscape disturbance and urbanization of the San Francisco Bay region affects genetic connectivity and diversity of the California Ridgway's Rail (*Rallus obsoletus obsoletus*)	Dustin Wood
9:40-10:00	***BREAK***	
10:00	A Tale of Two Songbirds: Contrasting Effects of Habitat Fragmentation Between Coastal Sage Scrub Obligates.	Amy G. Vandergast

10:20	Population structure in mule deer (Odocoileus hemionus) across major highways in Southern California	Devaughn Fraser
10:40	Genetic mark recapture of southern mule deer reveals limited seasonal movement and genetic structure across San Diego County.	Anna Mitelberg
11:00	Connectivity among populations of the endangered San Diego fairy shrimp in a military landscape	Natalie Goddard
11:20	Is genetic admixture in the San Diego fairy shrimp (Branchinecta sandiegonensis) associated with vernal pool disturbance?	Ketan Patel

14. Special session: Montezuma Hall

1:00- 5:30 **Urban Wildlife: Working Together for a Wilder Future**

A participatory session to explore how the challenges of open space and wildlife conservation are being met in a variety of US metropolitan regions. Through theme- and place-based short talks, panel sessions, and audience engagement, we will examine how scientists, land managers, and city planners have worked together to conserve and manage open space and wildlife in and around cities.

Tuesday 6 June All Conference Session: Urban Wildlife: Working Together for a Wilder Future

1:00PM - 5:30PM, Montezuma Hall

Join us for this half-day session to explore how challenges of open space and wildlife conservation are being met in urban regions across the US. Through short talks, panel sessions, and audience discussion, we will explore how city planners, policy makers, land managers, and scientists work together to conserve and manage urban open space and wildlife.

Online resources for this session available at http://www.urban-wildlife.org/specialsession.html

Urban Wildlife Context (1:00PM - 2:00PM). Urban open space and wildlife conservation depends on the landscape, legislative, and legal context of the region. Setting the stage for the program, representatives from six urban regions - Boulder, Chicago, Los Angeles, Raleigh (Wake County), Tucson (Pima County), & San Diego - will introduce the specific contexts in which they work and discuss how place-based factors - including the amount and distribution of natural areas, public, and private land, the number of jurisdictions involved, and the use of regulatory and voluntary approaches - affect urban wildlife conservation.

Living with Wildlife (2:00PM - 3:00PM). Conservation in urban regions increases interactions - both positive and negative - among people and wildlife. Urban wildlife conservation means balancing conservation and recreation, providing outreach and education about wildlife, mitigating roadway impacts, and addressing other conflicts between people and wildlife. What actions have cities taken in land management, planning, and science to accentuate the positive and reduce the negative interactions?

Semi-Structured Break (3:00PM - 3:30PM). Gather in the courtyard for refreshments and conversation. Panelists will be grouped by theme - Living with Wildlife, Creating Landscape Linkages, and Working Together.

Creating Landscape Linkage (3:30PM - 4:30PM). Wildlife movement around and through urban regions is essential to support urban wildlife and their natural systems. However, wildlife movement depends on a urban landscape that includes connected ecological networks. Representatives from several regions will share their experiences supporting and promoting landscape connectivity.

Working Together for a Wilder Future (4:30PM - 5:30PM). Conserving and managing open spaces and viable wildlife populations in urban regions requires navigating many challenges, including competing priorities for limited funding and differing views about open space, wildlife, and where, whether, and how conservation should be carried out. In this session, panelists and participants will share their experiences on how partnerships among city planners, policy makers, land managers, and scientists have helped to meet these challenges.

Special Session Participate

URBAN REGIONS

- Boulder:
- Chicago:
- Los Angeles:
- Pima County (Tucson Region):
- San Diego:
- Wake County

PANELISTS

- Michael Beck, San Diego Director, Endangered Habitat League
- Paul Beier, Professor, Northern Arizona University
- Carolyn Campbell, Executive Director, Coalition for Sonoran Desert Protection
- Liz Crosson, Water Policy Advisor for Office of Mayor Eric Garcetti, Los Angeles
- Katie Coyne, Associate Planner & Ecologist, Asakura Robinson
- Deborah Fowler, Open Space Manager, Wake County Parks, Recreation & Open Space
- Stanley Gehrt, Professor, Ohio State University
- Mark Hostetler, Professor, University of Florida
- Megan Jennings, Research Ecologist Adjunct Assistant Professor, San Diego State University
- Liza Lehrer, Urban Wildlife Ecologist, Lincoln Park Zoo
- Seth Magle, Director, Urban Wildlife Institute
- Kristeen Penrod, Executive Director, SC Wildlands
- Sherry Ruther, Environmental Planning Manager, Pima County Office of Sustainability & Conservation
- Niamh Quinn, Human-Wildlife Interactions Advisor, UC Cooperative Extension
- Andy Shrader, Director of Environmental Affairs, Water Policy, & Sustainability for Councilmember Paul Koretz, CD5, Los Angeles
- Heather Swanson, Wildlife Biologist, City of Boulder Open Space & Mountain Parks
- Jan Thompson, Professor, Iowa State University
- Susan Wynn, Biologist, US Fish & Wildlife Service

ORGANIZERS

- George Hess, Professor, NC State University
- Rebecca Lewison, Professor, San Diego State University
- Seth Riley, Wildlife Ecologist, US National Park Service

15. Ecology, behavior, and conservation of urban mammals : Templo Room

Moderator: Christopher DeMarco

8:00	Coyote and freeroaming cat detections are positively correlated in an urban wildland in Los Angeles	Travis Longcore
8:20	Cottontail rabbits (*Sylvilagus spp.*) as a potential urban food resource for bobcats (*Lynx rufus*) in a southern California landscape	Sean P. Dunagan
8:40	Habitat associations of an ecosystem engineer: returning the California ground squirrel to its rightful place	Sarah McCullough Hennessy
9:00	Comparison of Seasonal Movements Between Localized Populations of Urban and Rural White-tailed Deer (*Odocoileus virainianus*) in Southern Indiana	Garret Clevinger
9:20	San Clemente Island Fox: An Ambassador for Coexistence	Melissa Booker
9:40-10:00	***BREAK***	
10:00	To live and die in LA: Conservation Of The Western Gray Squirrel In Griffith Park through genetic analysis	Christopher DeMarco
10:20	Behavioural observations of eastern grey kangaroos in a suburban landscape	Jai Green-Barber
10:40	Aggression and boldness in Merriam's kangaroo rat: an urban-tolerant species?	Gizelle Hurtado
11:00	Avoidance Behavior and Diel Shifts by Mammals in Urban Reserves	Michael A. Patten
11:20	An investigation of learning, problem-solving, and behavioral flexibility in raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*)	Lauren A. Stanton

16. Dysfunctional urban biodiversity planning: Take home messages for (and from) ecologists and planners/designers: Pride Room

Moderator: Mark Hostetler

8:00	Building for Birds: A New Online Design Tool to Assess the Impact of Development	Mark Hostetler
8:20	Governing for diversity: What is the potential for fostering positive feedback among biodiversity, place attachment, and stewardship in urban green spaces?	Paige Warren
8:40	Building a Better Mousetrap: Proactively Managing Wildlife Damage in an Urbanized Landscape	David Drake
9:00	Let's Build Shared Vocabularies, Based on Values	David Maddox
9:20	How Small is Too Small? The role of protected area size and surrounding land use in conserving unique forest bird assemblages within an urban landscape	Jeffrey A. Brown
9:40-10:00	***BREAK***	
10:00	How Ecologists Can Make a Difference from a Planner's Perspective	Steve Hofstetter

10:20	You Want a Corridor for What?" Lessons from the Intersection of Urban Ecology, Planning, and Design	Travis Longcore
10:40	What have we learned from collaborative ecological landscape design in urban area in Japan?	Keitaro Ito
11:00	Integrating "Ways of Knowing" and "Ways of Doing" to Develop an Ecological Planning Approach to Urban Wildlife	Sarah Jack Hinners
11:20	Crossing the Science/Design Divide	Jason King

17. Coastal systems and wildlife in urban areas: Legacy Room

Moderator: Sheila Madrak

8:00	Thermal effluent and impacts on thermoregulation of aquatic reptiles: response to rapid changes in water temperature	Sheila V. Madrak
8:20	Sharing the beach: evidence of a white shark nursery off southern California beaches	Christopher G. Lowe
8:40	Implications of shifting home ranges of green turtles in a highly urbanized bay	Tomoharu Eguchi
9:00	A regional approach to assess sea-level rise impacts to North America Pacific coast tidal wetland habitats	Karen Thorne
9:40-10:00	***BREAK***	
10:00	Bayou City: Using Houston's Waterways to Connect People and Wildlife.	Kelly D. Norrid
10:20	Impacts of urbanization on the ecological condition of sandy beach ecosystems	Nick Schooler
10:40	Modeling Waterbird Habitat Associations to Inform Tidal Marsh Restoration in an Urbanized Estuary	Susan De La Cruz
11:00	Comparing persistent organic pollutants and trace metals in green sea turtles inhabiting two urbanized habitats in southern California.	Arthur Barraza
11:20	Malibu Lagoon: Results of Restoration, 2005-present	Daniel S. Cooper

18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes : Park Room

Moderator: Megan Jennings

8:00	From ensemble species distribution models to ensemble corridors: A case study from San Diego County	Kathy Zeller
8:20	Quantifying the structural and functional connectivity of habitat patches for Chicago area mesocarnivores	Mason Fidino
8:40	Connectivity planning under climate change for urban wildlife in southern California	Erin Conlisk
9:00	An assessment of connectivity between areas of high wildlife diversity and between habitats that are likely vulnerable to climate change in Washington, DC	Jennifer Murrow
9:20	Building science-management partnerships to develop actionable connectivity plans in urban southern California	Megan Jennings
9:40-10:00	***BREAK***	

10:00	Design and Implementation of a Wildlife Corridor in Metropolitan Tucson	Paul Beier
10:20	Preserving and increasing connectivity for wildlife in Los Angeles: long-term interagency planning, and efforts to build a wildlife overpass across 10 lanes of busy urban freeway	Seth Riley
10:40	Metro Habitat Connectivity Toolkit: Bringing Connectivity to an Actionable Scale	Leslie Bliss-Ketchum
11:00	Hahamongna to Tujunga Wildlife Corridor: Planning for Urban Wildlife	Nancy L.C. Steele
11:20	Coast to Cleveland wildlife corridor:retrofitting an urban landscape to facilitate wildlife movement	Elisabeth Brown

19. Urban large carnivores: Templo Room

Moderator: Jeff Sikich

1:00	King Of The Coast: Understanding Spatial Patterns Of Male American Alligators On A Georgia Barrier Island	Kimberly M. Andrews
1:20	Risky business: Black bear movement within developed landscapes	Michael Evens
1:40	Connectivity conservation for Tigers in a human dominated landscape	Indranil Mondal
2:00	Conserving Mountain Lions in Southern California: Addressing fragmentation, conflict, and excess human-related mortality.	Winston Vickers
2:20	Predictors of mountain lion body (Puma concolor) condition in the San Francisco Bay Area	Courtney Coon
2:40- 3:00	***BREAK***	
3:00	Puma (*Puma concolor)* survival in a fragmented landscape	Anna Nisi
3:20	Resource selection patterns of mountainlLions prey on mule deer along an urban wildland gradient	John Benson
3:40	Landscape and habitat use for a large carnivore in the city: use and selection for mountain lions around Los Angeles.	Jeff A. Sikich
4:00	Cougar Safe Trek: Leading the Next Generation of Wildlife Protection Along Highways – The Case of State Route (SR) 241	Doug Feremenga
4:20	Integrating habitat use and movement across space and time to create a multi-level, multi-scale conservation plan for puma in Southern California	Kathy Zeller

20. Urban partnerships - appreciation and conservation of wildlife: Pride Room

Moderator: Kristin Shaw

1:00	The Urban Wildlife Conservation Program and San Diego National Wildlife Refuge	Chantel Jimenez
1:20	An Urban Approach: The Don Edwards San Francisco Bay National Wildlife Refuge	Kristin Shaw

1:40	Connecting People to Nature Through Birding and Bird Conservation: The Urban Bird Treaty Program	Roxanne E. Bogart
2:00	Cultivating Connectedness	Kristin Shaw
2:20	A Monarch's View of a City: A Multi-City Landscape Conservation Design	Abigail Derby Lewis

21. Roads and urban wildlife: Pride Room

Moderator: Debra Shier

3:00	Effects of habitat enhancement on culvert use by small mammals	Debra M. Shier
3:20	The truth about roadkill: injury, cruelty and human responses	Fraser Shilling
3:40	Exploring and Predicting Elevated Vertebrate Road Kill From Ventura County to Louisiana to the Middle East	Sean Anderson
4:00	Caltrans District 11 – Wildlife Connectivity	Kim T. Smith
4:20	Integrating Fish & Wildlife Considerations into Transportation Projects	Amy Golden

22. Ethical wildlife control: Legacy Room

Moderator: Rebecca Dymytryk

1:00	Out of control wildlife control; the importance of utilizing more humane and effective approaches	John Griffin,
1:20	Not shaken or stirred, but covered in corn oil: Why aren't we addling more Canada goose eggs?	Lynsey White Dasher
1:40	Predator-Proofing Tips and Tricks	Sharon Ponsford
2:00	PEEP - An Interactive Living Laboratory	Danielle Mattos
2:20	Impacts to Nontarget Wildlife from Rodenticide Use in Urban Areas	Stella McMillin
2:40- 3:00	***BREAK***	
3:00	Barn Owls as Natural Pest Control	Doris Duncan
3:20	Introducing RatX	Jarid Gardner
3:40	Implementing an Effective Community-Supported Ordinance to Secure Trash from Black Bears: A Case Study from Boulder, Colorado	Valerie Matheson
4:00	Making A Killing Without Killing	Rebecca Dmytryk
4:20	What if everything you thought you knew about 'feral' cats was wrong?	Peter J. Wolf

23. Invaders and survivors: Reptiles and amphibs in urban ecosystems: Park Room

Moderator: Brad Shaffer

1:00	An Objective Road Risk Assessment Method for Multiple Species: Ranking 161 Reptiles and Amphibians in California	Cheryl Brehme
1:20	Geckos in the 'Hood: Rapid Continental Spread and Local Adaptation of an Urban Invasive Reptile	M. M. Dickson
1:40	Lizards Without Borders: Comparing Thermal Physiology Between Introduced, Urban Populations of the Italian Wall Lizard (*Podarcis siculus*) in New York and California	Daniel Haro

2:00	Poor Land Management Practices Impact Herpetofaunal Biodiversity Within Urban Habitats	Brian Hinds
2:20	Predicting Non-Native Invasions and Native Persistence within Miami-Dade County's Herpetofaunal Community	Christopher Searcy
2:40- 3:00	***BREAK***	
3:00	Does what we wear indirectly influence animals? A case study on the western fence lizard (Sceloporus occidentalis)	Bree Putnam
3:20	Detecting and Tracking Urban Invasives With Citizen Science	Gregory Pauly
3:40	Winners and losers in urban environments: sonoran desert lizards	Brian Sullivan
4:00	Everyone Wants to Know, "Where Are the Rattlesnakes, and Are They A Problem?"	Kimberly M. Andrews
4:20	Cryptic Urban Biodiversity: The Atlantic Coast Leopard Frog	Brad Shaffer

International Urban Wildlife Conference

June 4 - 7, 2017 | San Diego, California

Abstracts

Monday, June 05, 2017 (Morning)

Plenary Speaker

The Rise of Urban Ecology as an Integrative, Interdisciplinary Science for the Anthropocene

Dr. Nancy Grimm

Arizona State University

It is cliché to start an urban ecology abstract by saying that beginning in 2006, for the first time in history, more than half of the world's population lives in cities and that proportion is expected to rise to nearly 80% by the end of the century. Nevertheless, the gravity of the implications of such a major shift in world order cannot be overemphasized. Human impact on the environment, and resulting environmental changes that feed back to affect our lives, particularly in cities, is here to stay. As urban ecologists have begun to do, we need to develop new ideas and theory to set urbanization on a more sustainable trajectory. In this presentation, I will discuss the rise of urban ecology, focusing in particular on the United States after the funding of the first urban Long-Term Ecological Research (LTER) projects in Baltimore and Phoenix, which arguably was an inflection point for interest in and publications on urban ecology. I trace changes in conceptual frameworks, beginning with the ecosystem concept applied to cities, development of urban social-ecological systems theory and the press-pulse dynamics framework, to conceptualization of ecosystem services in cities, to social-ecological-technological systems (SETS) ideas. I then examine application of these ideas to the concept of disturbance, as developed by ecologists, and the problem of building resilience to the impacts of climate change. I contend that urban ecology is and must continue to be a central intellectual driver of understanding and improving cities in the Anthropocene, but that ecology looks very different from the field that spawned it.

1. Urban biodiversity

Understanding biodiversity in cities: ecological and socioeconomic filters

Charles Nilon[1], Myla Aronson[2], Chris Lepczyk[3], Tommy Parker[4], Paige Warren[5]

[1]University of Missouri; [2]Rutgers University; [3]Auburn University; [4]University of Memphis; [5]University of Massachusetts-Amherst

The Urban Biodiversity Research Coordination Network (UrBioNet) is National Science Foundation-funded research network designed to bring together researchers and managers to understand the factors that drive biodiversity in the world's cities. UrBioNet is organized around three goals: understanding the ecological and biogeographic factors that filter species found in cities from a regional species pool; understanding the socioeconomic and cultural factors shaping species composition and abundance within and among cities; and identifying best practices of monitoring, management, policy and design. In this presentation we will describe initial findings from working groups addressing the first two goals of the network. The patterns and traits working group is identifying common traits across taxa that are associated with species found in cities and exploring how this traits might be associated with broader ecological and biogeograhic factors. The socioecological linkages group has looked at social, demographic, and economic variables that have been shown to be correlated with species composition and abundance and how these variables are useful in understand patterns in cities with different development histories, spatial configurations, and styles of governance.

1. Urban biodiversity

If you build it will they come? Mammal diversity and metacommunity dynamics in different types of urban green space

Travis Gallo, Mason Fidino, Elizabeth W. Lehrer, and Seth B. Magle

Lincoln Park Zoo, Urban Wildlife Institute, Department of Conservation and Science, Chicago, IL

As urban growth expands and natural environments fragment, it is essential to understand the ecological roles fulfilled by urban green spaces. To quantify this we studied the metacommunity dynamics of medium-and large-sized mammals in city parks, cemeteries, golf courses, and natural areas throughout Chicago, IL, USA. We found similar diversity (with the exception of city parks), but remarkably dissimilar communities in different urban green spaces. Further, the type of urban green space greatly influenced species colonization and persistence rates. For example, coyotes (*Canis latrans*) had the highest but white-tailed deer (*Odocoileus virginianus*) had the lowest probability of persistence in golf courses compared to all other types of green space. Additionally, most species had an equally difficult time colonizing city parks even when potential sites were seemingly available. Our results indicate that urban green spaces contribute different, but collectively important, habitats for maintaining and conserving biodiversity in cities.

Drivers of native bee community composition in urban landscapes

Kimberly M. Ballare[1,2], John L. Neff[3], and Shalene Jha[1]

[1]University of Texas at Austin, Department of Integrative Biology; [2]University of Texas at Austin, Graduate Program in Ecology, Evolution, and Behavior; [3]Central Texas Melittological Institute, Austin, TX

As urbanization increases worldwide, ecologists must assess its impacts on native wildlife populations and ecosystem services they provide. One critical ecosystem service is pollination, where bees are the primary pollinators of both wild and cultivated plants. Little is known about how the size, spatial configuration and availability of nesting and floral resources impact native bee community composition and persistence in urban ecosystems. We conducted a community level survey of native bees along two gradients of urbanization in Austin and Dallas, TX. In each city we sampled 20 sites managed as either natural parks or farms (40 sites total). Bees were collected uniformly across sites, and the number of inflorescences of all flowering plants was counted. We assessed local site characteristics such as % vegetation and % canopy cover as well as land-use classifications within 2 km. We used linear mixed models to quantify the influence of local and landscape characteristics and floral resource availability on bee abundance and diversity. Bee species richness was significantly positively related to amount of semi-natural habitat within 2 km. There were significant effects of local habitat management, with bee abundance and species richness positively related to floral species richness, but only in natural sites. At farm sites, floral species richness did not have an effect on bee abundance or species richness. Bees that nest above ground were relatively more abundant and diverse at the natural sites, where bees that nest below ground were more abundant and diverse at the farm sites. Farm sites had more bare ground, suggesting that urban farms can provide good nesting habitat for below ground nesting bees. These results suggest that while urban development has a negative effect on bee communities at a landscape level, local habitat management of native flora at the patch level can encourage diverse native bee communities within cities.

1. Urban biodiversity

Partitioning the effects of habitat fragmentation on rodent species richness in an urban landscape

Alex M. Johnson[1,2], and Tim J. Karels[1]

[1]Department of Biology, California State University, Northridge, 18111 Nordhoff St., Northridge, CA 91330-8303; [2]Department of General Studies, Trinity Bible College, 50 6th Ave. South, Ellendale, ND 58436

Habitat fragmentation plays a major role in species extinction around the globe. Previous research has determined that species richness in fragments is affected by a number of characteristics including fragment age, size, and isolation, edge effects, vegetation coverage, habitat heterogeneity, and matrix content. Although most studies focused on one or a few of these characteristics, multiple characteristics work together to affect species richness, showing that the effects of habitat fragmentation are complex. The goal of our study was to partition the complex effects of urban habitat fragmentation by determining the direct, indirect, and cumulative effects of multiple habitat fragment characteristics on rodent species richness. In 2013, we determined rodent species richness in 25 habitat fragments within Thousand Oaks, California. In addition, we measured the following characteristics for each fragment: fragment age, area, isolation, shrub coverage, habitat heterogeneity, perimeter/area ratio, and percent non-urban buffer. Path Analysis was used to test the hypothesized model which described the direct, indirect, and cumulative effect of each habitat fragment characteristic on rodent species richness. Overall, the path model explained 67% of the variation in rodent species richness among habitat fragments. Habitat heterogeneity had the greatest direct and total effect on rodent species richness. Fragment size had the next greatest total effect on rodent species richness but this was nearly entirely indirect through its influence on habitat heterogeneity. Our study shows that large habitat fragments support the greatest habitat diversity, which provides the highest likelihood of conserving rodent species richness in urban landscapes.

Developing a Biodiversity Atlas for Los Angeles County

Shenyue Jia, Thomas W. Gillespie, and Monica Dimso

Department of Geography, University of California, Los Angeles, CA 90095, USA

Southern California is a biodiversity hotspot under the pressures of both climate change and continued urban development. An atlas that can illustrate and evaluate the current status of biodiversity, as well as the environmental determinants of species richness, is not only useful for the scientific community,but also valuable in communicating the importance ofconservation to the general public. We have collected and mapped a series of environmental factors that shape and impact biodiversity in Los Angeles County in the form of an online map resource. These factors include, and will go beyond: current and projected climate variables (*i.e*. air temperature, precipitation), topography, tree canopy coverage, surface imperviousness, accessibility, degree of light pollution, and spatially continuous population density. Using species occurrence data from both federal/state agencies and citizen scientist programs, these layers were also used to producespecies distribution models for endangered and threatened species, as well asa selection of common southern California species. The predictive models, assembled using Maxent, feature a higher spatial resolution (1 km or 1 ha) than the richness maps that are currently available. These probability models of species occurrence will also be used to identify priority areas for biodiversity conservationin Los Angeles County. Intended to serve as both a science-based tool for decision-makers and an educational resource for the general public, the final Atlas productwill highlight the unique biodiversity of the Los Angeles County and emphasize the significance of regional conservation and sustainability efforts.

1. Urban biodiversity

Urban Bat Community Composition along a Rural to Urban Gradient

Ela-Sita Carpenter and Charles H. Nilon

University of Missouri, School of Natural Resources, Columbia, MO

Some studies have suggested that bats are good indicators for determining urbanization's impact on wildlife due to their relatively long lifespan and monoestrous characteristic. The purpose of this study was to determine the role urbanization plays on bat community composition by investigating it along an urban-rural gradient. The Gwynns Falls Watershed (GFW) is a 3,600 ha watershed that begins in southwest Baltimore County, Maryland and flows southeast into central Baltimore City. It was hypothesized that urban bat species richness and activity would decrease as the GFW transitioned from suburban to urban, resulting in different species compositions along the gradient. From May to August 2016, active acoustic monitoring was conducted at nine sites adjacent to water gauges along the GFW. Environmental data was gathered at each site during each visit as well. Over 1,600 calls from seven species were recorded. Big brown bats (*Eptesicus fuscus*) and red bats (*Lasiurus borealis*) were present at all sites. Other species present included *L. cinereus*, *Lasionycteris noctivagans*, *Nycticeius humeralis*, *Myotis* spp., and *Perimoytis subflavus*. Bat species richness did not decrease as hypothesized; in fact, the most species-rich site was the second most urban site. The amount of bat activity also varied at each site and did not appear to follow a pattern. It is likely that additional factors (*e.g.*, the surrounding landscape) play an important role in species composition (perhaps moreso than urbanization), as the most active sites were adjacent to large forested areas. We also wanted to begin investigating the role habitat type and size play in bat community composition within the city, so a small pilot study was conducted looking at various sized parks and vacant lots, and those results will be briefly shared as well.

Determining Species-Specific Nightly Bat Activity in Sites with Varying Urban Intensity

Sarah Schimpp, Han Li, and Matina Kalcounis-Rueppell

University of North Carolina, Greensboro, NC

Time of peak bat activity during the night differs among bat species. Foraging strategies may differ among species due to prey availability, habitat availability, and/or interactions between species. Habitat availability is altered in urban areas, which may affect insect prey availability and interspecies interactions. It is not known if the nightly temporal foraging strategies of bats are also altered in urban areas. Our objectives were to use mobile acoustic monitoring to determine when bat species are active at night and if the timing of bat activity differs between sites with varying urban intensity. We recorded bat echolocation calls using AnaBat acoustic detectors while driving transects through the night at five sites (three “urban”and two “non-urban”) located in the Piedmont region of north-central North Carolina from May through August 2016. Transects were driven three times per night in rounds starting 45 minutes, 180 minutes, and 300 minutes after sunset. Recorded echolocation call sequences were analyzed manually using AnalookW and automatically using Bat Call Identification and Echoclass software. There were significantly more *Eptesicus fuscus*, *Lasionycteris noctivagans*, and *Nycticeius humeralis* calls recorded on the earliest round compared to the latest round. There were also significantly more *E. fuscus* calls recorded on the earliest round compared to the second round. There were more *E. fuscus*, *L. noctivagans*, and *Tadarida brasiliensis* calls in urban sites compared to non-urban sites and there were more *Lasiurus borealis*, *N. humeralis*, and *Perimyotis subflavus* calls in non-urban sites compared to urban sites. These results suggest that nightly bat activity does differ depending on species and urban intensity, which important to consider when studying effects of urbanization on bats.

1. Urban biodiversity

Measuring Urban Biodiversity: New Web Portal to Support the City Biodiversity Index

Jennifer Rae Pierce[1], Pablo Arturo López Guijosa[2], and Melissa Alane Barton[3]

[1]University of British Columbia; [2]World Commission of Protected Areas, IUCN; [3]City Biodiversity Index Coalition

Over 50 cities worldwide have created biodiversity strategies, recognizing the crucial role that urban biodiversity plays in the social, physical, and environmental health of city environments, providing valuable ecosystem services and community-building opportunities. Unfortunately, some cities may lack sufficient resources to execute and evaluate their biodiversity strategies. In 2008, Parties to the Convention on Biological Diversity recognized the need for a measurement tool for cities' biodiversity efforts. Accordingly, the Government of Singapore's National Parks Board (NParks) coordinated the creation of the City Biodiversity Index (CBI), or Singapore Index, which generates a quantitative measure for each city's biodiversity strategy, incorporating three factors: biodiversity assessment, ecosystem services, and governance. Since CBI's launch in 2010, approximately 20 cities have officially used the index to measure their biodiversity. The CBI remains the most robust and comprehensive system for cities to measure their biodiversity strategies. However, it is underutilized and would benefit from additional organizational support. In order to reduce barriers to use the CBI and facilitate measurement of local and global urban biodiversity outcomes, the City Biodiversity Index Coalition was formed in 2016. The CBI Coalition is an international volunteer organization that is partnering with NParks to support the CBI. This year, the CBI Coalition is focused on the development of a one-stop web portal that will bring together urban biodiversity initiatives from around the world and support cities in their application of the CBI. The web portal will facilitate index calculation and data analysis for cities, and will include educational tools and connections to experts for all visitors. This presentation will introduce the web portal and invite attendees to join the CBI Coalition in our goal of linking urban biodiversity efforts and supporting cities with their urban biodiversity strategies.

Introducing the Urban Wildlife Information Network: An Integrated Approach to Urban Wildlife Research

Seth Magle, Liza Lehrer, and Mason Fidino

Urban Wildlife Institute, Lincoln Park Zoo, Chicago, IL

Lincoln Park Zoo's Urban Wildlife Institute has been conducting urban wildlife research in the greater Chicago area since 2009, including studies of mesocarnivores, bats, arthropods, and on human dimensions of wildlife. We have developed a robust, generalizable approach to wildlife monitoring that uses multiple approaches in tandem (*e.g.* motion-triggered cameras, ultrasonic bat monitors) along urban-to-rural gradients in multiple seasons across numerous years. We will briefly describe the results of some studies from this research, and will also introduce the Urban Wildlife Information Network, a nation-wide effort to synchronize studies of wildlife species in cities by using the monitoring approaches developed in Chicago. This network now includes partners in Kansas, Colorado, Indiana, and Wisconsin, and will continue to expand in the years to come. We contend that only by expanding urban wildlife research beyond our individual study areas and making broad-scale comparisons between cities can we differentiate local patterns in urban wildlife from universal ones. In so doing, we can for the first time generate global-scale recommendations for conservation and management of urban species.

1. Urban biodiversity

¡BAILA! Biodiversity Assessment In Los Angeles

John M. Randall[1], Brian V. Brown[2], Brian S. Cohen[1], Enjie Li[1,2], Sophie S. Parker[1], and Gregory B. Pauly[2]

[1]The Nature Conservancy, San Diego, CA; [2]Natural History Museum of Los Angeles County, Los Angeles, CA

Greater Los Angeles is a famously dynamic metropolis with an unparalleled richness of natural habitat and wildlife in the mountains and hills that surround it, and one of the nation's lowest per capita acreage of and worst access to parks and open space. Interest and tangible progress in increasing habitat quality in the city, and increasing people's exposure to nature, are growing across the region. A missing piece needed for this transformation is a region-wide vision for nature based on a comprehensive understanding of where habitat and wildlife are and where there are practical opportunities to restore, rehabilitate, and connect them. The Nature Conservancy and Natural History Museum of Los Angeles County have partnered and enlisted input from stakeholders and leading scientists to complete an up-to-date biodiversity assessment for the entire region. It largely follows the Conservancy's conservation planning framework but uses non-traditional conservation targets such as non-native plant dominated habitats that support native animals as well as more traditional targets such as rare and keystone species and natural communities. It will yield a spatially explicit, wall-to-walldatabase and map of conservation value and potential conservation value that encompasses dense residential, industrial and commercial areas as well as natural areas and open spaces. Several agencies, organizations and decision-makers have already asked for this kind of information for major land use, infrastructure, development, and funding decisions across the region. We are offering it to a host of stakeholders so it may inform a consensus around a spatially explicit vision for nature across Greater Los Angeles that includes remaining natural habitat, plus neighborhoods, commercial and industrial areas whose buildings, bridges and ornamental plantings support nesting native birds and feeding lizards, and whose vegetated lots support native crickets, bees, and myriad other small creatures.

2. Wildlife soundscape in anthropogenic environments

A synthesis of two decades of research documenting the effects of noise on wildlife

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Global increases in environmental noise levels have led to a recent pulse of scientific research into the effects of noise on wildlife. It is clear that noise presents diverse threats to wildlife, and that salient patterns are emerging that can help inform future natural resource management. We conducted a systematic and standardized review of the scientific literature published from 1990-2013, with updates for 2014-2016, on the effects of anthropogenic noise on wildlife. The goals were to summarize primary research foci, evaluate key areas of knowledge, and synthesize information on biological responses to different noise levels. Research to date has concentrated predominantly on species that rely on vocal communication, with approximately two-thirds of the dataset focusing on songbirds and marine mammals. The majority of studies documented effects from noise, including altered vocal behavior to mitigate masking, avoidance and thus reduced abundance in noisy habitats, changes in vigilance and foraging behavior, and impacts on individual fitness and the structure of ecological communities. Our comparative analysis of the literature documents congruous responses to noise levels across taxa and biological responses, with 50% of the terrestrial studies reporting a biological response at or below 60 dB (re 20 µPa). Future research directions that would support more comprehensive predictions regarding the magnitude and severity of noise impacts include: broadening taxonomic and geographical scope, exploring interacting stressors, conducting larger scale studies, testing mitigation approaches, standardizing reporting of acoustic metrics, and assessing the biological response to noise source removal or mitigation. The broad volume of existing information concerning the effects of anthropogenic noise on wildlife offers a valuable resource to assist scientists, industry, and natural resource managers in predicting potential outcomes of noise exposure.

2. Wildlife soundscape in anthropogenic environments

Effects of broadband anthropogenic noise on behavior of free-living deer mice (*Peromyscus maniculatus*)

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Anthropogenic noise is a pervasive environmental pollutant that exceeds natural sounds spatially, temporally and in frequency composition. Animals rely on acoustic signals to mediate a myriad of daily activities. Anthropogenic noise can interfere with the production and propagation of acoustic signals, which in turn can influence animal behavior, physiology, and survival. In general, noise negatively affects acoustic signals in two ways, by: 1) masking acoustic signals, and 2) eliciting energetically costly anti-predator behaviors. There is a knowledge gap on how rodents perceive and respond to broadband anthropogenic noise in complex field settings. Our hypothesis is that broadband anthropogenic noise alters allocation of time and energy spent toward behaviors that influence fitness. In the summer of 2016, we live-trapped deer mice (*Peromyscus maniculatus*) in Nantahala National Forest, NC, USA, and outfitted 4 resident mice (captured more than 3 times) with a radio transmitter. Based on each mouse's spatial preference we deployed three remote sensing systems: microphone array, stationary telemetry, and thermal imaging for six nights. On the first three nights we monitored mice behaviors without introducing noise (control). On nights four to six, we broadcasted anthropogenic noise from a road generator (treatment). We recorded vocalizations, monitor movements, and foraging activity of each collared mouse. We predict that mice exposed to noise would produce fewer vocalizations and decrease movement and foraging activity. Furthermore, if mice vocalized during noise exposure, we predict a shift in spectral characteristics of vocalizations (frequency, duration and amplitude). We will use paired t-tests for our predictions. We will present our results emphasizing that broadband anthropogenic noise shifts energy away from fitness enhancing activities.

The chorus versus the road: the spatiotemporal constraint of anthropogenic noise and the importance of communication networks in Pacific chorus frogs

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Loss of acoustic habitat due to anthropogenic noise is a key environmental stressor for vocal amphibian species, a taxonomic group that is experiencing global population declines. The Pacific chorus frog (*Pseudacris regilla*) is the most common vocal species of the Pacific Northwest and can occupy human-dominated habitat types, including agricultural and urban wetlands. This species is exposed to anthropogenic noise, which can interfere with vocalizations during the breeding season. We hypothesized that Pacific chorus frogs would alter the spatial and temporal structure of their breeding vocalizations in response to road noise, a widespread anthropogenic stressor. Pacific chorus frogs were unable to change their vocalizations to compensate for road noise. A model of the active space and time ("spatiotemporal communication") over which a Pacific chorus frog vocalization could be heard revealed that in high-noise habitats, spatiotemporal communication was drastically reduced for an individual. This may have implications for the reproductive success of this species, which relies on specific call repertoires to portray relative fitness and attract mates. Using the acoustic call parameters defined by this study (frequency, source level, call rate, and call duration), we developed a simplified model of acoustic communication space–time for this species. This model can be used in combination with models that determine the insertion loss for various acoustic barriers to define the impact of anthropogenic noise on the radius of communication in threatened species. Moving forward, we are working on developing ways of determining the impact of anthropogenic noise on the frog chorus as a whole, rather than the individual, by using network analysis. As male frogs will respond vocally not only to their environmental noise but also to each other, anthropogenic noise impacts may cause a positive feedback that further reduces frog vocalization and spatiotemporal communication. Reduction in acoustic habitat by anthropogenic noise may emerge as a compounding environmental stressor for an already sensitive taxonomic group.

2. Wildlife soundscape in anthropogenic environments

Bioacoustics: A tool for wildlife management?

Darren Proppe

Calvin College, Grand Rapids, MI, USA

Animals live in an ever-changing world where sensory input differs dramatically from what was present in the recent past. For example, low-frequency acoustic stimuli – once associated primarily with wind and water – are now an ever-present side product of human development. Much of the behavior we observe in animals has evolved in response to a particular set of sensory inputs. As a result, our anthropogenic takeover of the soundscape, especially in the urban environment, is often associated with the loss of diversity and abundance in wildlife species. Given that many anthropogenic disturbances, like roads and industry, are unlikely to disappear in the near future, urban wildlife managers could gain from asking how we can manipulate the acoustic environment; to our advantage. Since we know animals respond to acoustic stimuli, can we add particular acoustic cues and signals to the environment that will reduce stress in urban fauna, enhance the utilization of our cities by native species, and reduce the potential for human wildlife conflict? Studies using acoustics to modify behavior are limited and the results are sometimes mixed, but we are currently investigating song playback as an acoustic cue that might increase the establishment of songbirds in areas exposed to anthropogenic noise. Alongside playback studies, we are working towards a broader understanding of the ultimate fitness impacts of noise on songbirds. While birds are highly tuned to the acoustic environment, employing acoustic stimuli for management may also be feasible in other organisms. And, while we are currently working to reduce aversive behavior in songbirds, acoustic stimuli might also be used to induce fear of novel, anthropogenic hazards. In sum, advocating for the reduction of human disturbance is ideal, but using bioacoustics to assist in wildlife management within the current context may also contribute to the health and survival of urban species.

Bat species diversity and distribution in a highly urban ecosystem

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As bat populations face increasing pressures from disease, wind energy, and habitat loss, understanding the effects of urbanization is vital for conservation. Species responses to urbanization are likely context-dependent and species-specific, but more information is needed before we can recognize broad patterns. During May-September 2013-2015, we used passive acoustic detectors (SM2BAT+; Wildlife Acoustics) to record full spectrum echolocation calls at 22 study sites located across a 70km urbanization gradient beginning in downtown Chicago. Calls were analyzed using Sonobat and a subset was vetted by researchers. Our objectives were to 1) identify the current bat species community in greater Chicago area and 2) examine the influence of landscape factors on species distribution. We used a multi-season, multi-species occupancy model within a Bayesian framework to examine the influence of canopy cover, distance to water, and amount of impervious surface on colonization and persistence. We observed high species diversity at sites across the gradient, even at sites within the urban core. We detected up to 7 species at both urban and rural extremes, including those species impacted by WNS (*Eptesicus fuscus, Perimyotis subflavus, Myotis* sp.); the majority of recordings were *E. fuscus* (51%). Previously not detected in Chicago, *N. humeralis* were recorded at sites across the gradient throughout the study. Occupancy modeling revealed differential effects of landscape factors on colonization and persistence across species. Our results can inform future monitoring and conservation efforts for bat populations in urban areas.

2. Wildlife soundscape in anthropogenic environments

Threshold patterns in urbanization's effects on bat soundscape

Han Li and Matina C. Kalcounis-Rueppell

Department of Biology, The University of North Carolina Greensboro, Greensboro, NC, USA

Urbanization is a rapid process that converts natural habitats for human's needs. By removing local flora and fauna, urbanization creates new ecological niches. Wildlife shows different responses to urban habitats. Studies have found that urbanization has species-specific effects on bats. For example, the big brown bat (*Eptesicus fuscus*) and Mexican free-tailed bat (*Tadarida brasiliensis*) are found adapting to cities more successfully than other bat species; whereas species from genus *Myotis* usually avoid urban habitats. Species that can adapt to urban habitats well usually take the advantage of the new niche and exploit food, water, or roost resources that cities provide. Therefore, bat species composition and acoustic activities are different in urban areas compared to the undeveloped areas nearby. So far no study has tested if the intensity of urbanization would impact its effects on bats. We hypothesized that urbanization's effects on local bats would only be found when urbanization reached a certain intensity. In 2015 and 2016 summers, we established 17 urban-nonurban bat monitoring site pairs in North Carolina, USA. We followed the North American Bat Monitoring Program (NABat) stationary point survey protocol and recorded bat acoustic calls simultaneously for 4 consecutive nights at each urban-nonurban site pair. We used human population density as the index of urbanization intensity. Regression models were constructed to identify threshold patterns in how urbanization intensity affected bat soundscape variables. We found that only when a human settlement reached a certain size, the settlement center would lose some local species. We also found that bats tended to emergence earlier in urban areas than nearby non-urban areas. However, this difference could only be found in large cities. We suggested that the effects of urbanization on bats depended on the intensity of the city development. Local bat soundscapes might not be affected if urbanization was not intense.

Using bioacoustics in a rapidly urbanizing landscape to monitor biodiversity and engage the community in sound

J. Amy Belaire[1], Barbara Dugelby[1], Aaron Haynes[1], Olivia Leos[1], Gabriela Macias[1], Caleb Spitz[1], Preston Wilson[2], and David Knobles[3]

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Bioacoustic monitoring offers a powerful tool to monitor biodiversity over time and space, especially in rapidly urbanizing landscapes, such as those in and around Austin, Texas. Wild Basin is a 227-acre natural area that provides 3 miles of hiking trails within a 10-minute drive of downtown Austin. Approximately 10,000 students and adults visit Wild Basin annually to experience the native Texas Hill Country ecosystem. The Wild Basin Acoustic Biodiversity Monitoring Project focuses on the effects of urbanization on bird and anuran communities at Wild Basin. Wild Basin is home to the federally endangered Golden-Cheeked Warbler and many other native wildlife species that are affected by habitat loss, fragmentation, and other anthropogenic factors associated with urbanization. With this project, we have begun tracking changes in bird and anuran communities as the surrounding landscape becomes increasingly urbanized. In addition, through a strong outreach program, we share bioacoustic information with students and the public, helping them identify wildlife sounds as they explore the preserve and understand the value of acoustic monitoring for biodiversity conservation. In this presentation, we share findings from our initial season of data collection along with examples of how we share these results with broader audiences to engage them in discussions about conservation and biodiversity in urban ecosystems.

2. Wildlife soundscape in anthropogenic environments

Mon Paysage Sonore: connecting urban and arctic schools through soundscapes

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Our project Mon Paysage Sonore/My Soundscape aims to introduce primary school students to biodiversity by engaging them in a Citizen Science project initiated with a Wildlife Acoustics Scientific Grant. We are currently gathering soundscape data from a tree in front of our school, École Étoile filante, on a busy street corner across from a large urban park in Montréal using an SM4 recorder. Our EchoMeter Touch Bat detectors uncover species few noticed before our first Bat Walk. A second SM4 recorder, destined for a partner school in the Arctic next year, is currently gathering data from different student's neighborhoods in between our Soundwalks. Older students on Soundwalks participate by noting sound signals (event-based sounds) and sound markers (background sounds) they hear as we walk near the school. Because we also see animals that are not vocalizing during our walks, sixth graders created another category, sound potentials for our lists. Younger students write down all the sounds they hear, usually by writing the sound itself (woo-woo) rather than the source (fire truck siren), and also tend to see fewer animals as the groups tend to be noisier. We are just beginning to annotate the Songscapes we have now been gathering since July 2016. Students are learning to designate sounds as Biophony, Geophony, or Anthrophony, and creating their own short compilations of sounds and spectrograms to share "their" soundscape with the rest of the school. As an example of the complicated social-scientific interactions inherent in urban biodiversity projects, when first and second graders were asked to form teams by choosing sound-producers from a toy pile, we unintentionally ended up with Team Anthrophony dominated by boys, and Team Biophony exclusively made up of girls. Our lessons-learned are rapidly informing our lesson plans as we move forward.

NHMLA Backyard Bat Survey

Miguel Ordeñana

Natural History Museum of Los Angeles County, Los Angeles, CA

Previous bat studies in Southern California have focused on large urban parks, so there is a scarcity of data on how bats use the core of urban habitat such as residential areas. Backyards and private property comprising the bulk of urban areas are typically inaccessible to researchers, therefore previous studies have been limited in scale to secure public spaces. The Natural History Museum of Los Angeles County (NHMLA) aims to overcome this limitation by working with homeowners to incorporate bat acoustic monitoring into a preexisting multi-disciplinary biodiversity survey called the SuperProject. The SuperProject is a multi-year backyard survey of various taxonomic groups and environmental data along multiple habitat gradients. Homeowners agree to host research equipment (*e.g.*, flying insect traps, camera traps) which are monitored by scientists, in addition to completing diurnal citizen science surveys for various taxonomic groups via the iNaturalist app. The objectives of the incorporation of a bat study into the SuperProject were to measure the impacts of environmental variables such as foraging availability and proximity to the urban edge on bat species activity and species richness in backyards. The SuperProject completed its first sampling season in October 2016. Bat detectors were deployed in 8 of 18 SuperProject backyards between Santa Monica, CA and Riverside, CA for one month each. Twelve species were detected, which included five species listed as vulnerable and species of special concern by the state of California. Six of the twelve species were considered uncommon or new records to the Greater Los Angeles area. The results of the study will provide data that can inform property owners and city planners how to provide suitable habitat for bat species in urbanized and urbanizing landscapes. We are currently looking into novel ways to get participants involved in data analysis and other parts of the scientific process.

3. Communication and education

Raising Wildlife Awareness in New York City: Lessons, Challenges and Opportunities

Sarah Aucoin (Chief, Education and Wildlife), Richard Simon (Director, Wildlife Unit), and Katrina Toal (Senior Operations Coordinator, Wildlife Unit)

New York City Parks and Recreation, New York, NY

Emergent urban wildlife issues are on the rise in New York City. Increasing populations of raccoons, white-tailed deer, eastern coyotes, red fox, and red-tailed hawks present management challenges as well as educational and research opportunities. The presence of endangered species and protected migratory birds in the City highlight the need for dedicated conservation efforts. As urban wildlife populations increase, so do human/wildlife interactions and the potential for negative interactions and conflict. Public education, outreach and engagement is critical to any wildlife management program. Urban Park Rangers have been on the front lines of educating New Yorkers about wildlife for over three decades. More recently, New York City has recently launched a targeted public education campaign called WildlifeNYC to increase public awareness about wildlife in the City, and has created the first ever Wildlife Unit within the Department of Parks and Recreation to promote coexistence between people and wildlife in the City.

Texas urban wildlife program's insight to participating in the n.w.f. mayor's monarch challenge to get a city to actively support wildlife conservation from the top down

Judit Green

Texas Parks & Wildlife Department, San Antonio, TX 78254, USA

The Urban Wildlife Program of the Texas Parks & Wildlife Department (TPWD), formed in 1993, serves seven major metropolitan areas in Texas. The mission for each urban biologist is to connect with millions of residents in their area to ensure that natural resources in Texas are maintained for future generations. To do this, it is imperative to work with local partners to reach the masses that often influence and/or impact the natural resources in their communities by their actions and/or inactions. Most recently, TPWD's Urban Wildlife Program in San Antonio has partnered with the city and others to help Mayor Ivy Taylor take on the National Wildlife Federation's Mayor's Monarch Pledge (www.nwf.org/mayorsmonarchpledge). San Antonio was the first city in the nation to accept all 24 steps of the pledge to create monarch/pollinator habitat throughout the city and educate residents about how they can make a difference at home. 2016 was off to a great start with various outreach events and the completion of a management plan written together by all partners of the Alamo Area Monarch Collaborative. Implementation of the plan will hopefully help the iconic monarch butterfly, as well as other valuable pollinators, as they migrate through Texas on their north and southbound journeys. The Urban Wildlife Program will encourage the use of the TPWD Texas Wildscape plan and online documents (Management Recommendations for Native Insect Pollinators in Texas and Identification of Milkweeds in Texas) to help provide native plant information since most of the United States impacts monarch populations if native milkweed and flowering plants are not available to them during migration. Small or large, city or rural—all properties are important in this endeavor.

Wildscape Plan: http://tpwd.texas.gov/huntwild/wild/wildlife_diversity/wildscapes/
Pollinator Management: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_w7000_1813.pdf
TX Milkweeds: https://tpwd.texas.gov/publications/pwdpubs/media/pwd_rp_w7000_1803.pdf

3. Communication and education

Our Biodiversity Hotspot - Engaging San Diego County Students with Wildlife

Kimberly Kutina[1] and Kristina Goff[2]

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Feeling connected to nature is arguably a pre-requisite for environmental stewardship. Even beyond a feeling of connectedness, successful conservation efforts require community awareness and support, especially for those living in biodiversity hotspots. In this presentation, we highlight two programs that showcase our efforts to engage Southern California students with local wildlife in order to foster connectedness, awareness, and support.The Eddy Family Outdoor Learning Lab is a one-acre parcel of restored coastal sage scrub habitat on the campus of the San Diego Zoo Institute for Conservation Research, located in Escondido's beautiful San Pasqual Valley. The associated "Life in a Biodiversity Hotspot" curriculum is designed to connect students and teachers to nature as they learn about and observe native plants and animals, as well as to positively influence attitudes toward conserving local biodiversity and their ability to contribute meaningfully to local conservation efforts. Visiting students and teachers engage with several biodiversity monitoring techniques: pitfall traps, audio traps, camera traps, and plant transects. As they explore these techniques, an interactive digital field notebook encourages them to practice observation and data collection skills, and critically evaluate how human-mediated change in our environment impacts the health and composition of natural systems.San Diego Zoo Global is also partnering with the Escondido Creek Conservancy and Olivenhain Municipal Water District to bring a unique 3-part program called "Backyard Biodiversity Hotspot" to students in park-poor areas of San Diego County, focusing on the biodiversity hotspot in their own backyard. This exciting new program includes a classroom session, a visit to the Outdoor Learning Lab, and a field trip to Elfin Forest Recreational Reserve in Escondido. Through up-close animal presentations and engaging activities that align with Next Generation Science Standards, we encourage students tohelp protect and improve the environment.

An Absolute Game Changer for Wildlife Conservation: What you need to know and Why you should be Involved

Richard Heilbrun

Texas Parks & Wildlife Department, San Antonio, TX

There are more than 12,000 species and habitats of concern. Our greatest asset in recovering sensitive populations is the ability to work on them before numbers reach a critically low threshold and before habitat threats make long-term recovery improbable. But how do we do that? Every state has a State Wildlife Plan that lays out a roadmap for recovering these populations, but there are significant barriers to implementation. We as natural resource professionals have limited funding, limited time, and too few people working on these rare species. But that may be about to change. A new national initiative has begun, and if successful, would be a complete game change for wildlife conservation. Over the next 2 years, the conservation community will participate in an all-out blitz to find solutions that that will enable us to address populations of greatest concern and to prevent the need to add additional species to that list. This presentation will address what is being done at the state and national levels, how this effort will benefit both urban and rural conservation efforts, how this initiative impacts the issues you care about, and what your organization needs to know about this movement that can only be described as a game changer in the world of natural resource conservation.

How to Get the Science Out to the Public and Decision-Makers

Joel Schulman

Poison Free Malibu, 1832 Lookout Road, Malibu, CA 90265

We are a nonprofit organization that works to educate the public, business, homeowners, and others about the harm that is being done to predator wildlife by rodent poisons. We started activities in 2013 in the Santa Monica Mountains of Los Angeles County and have subsequently become active California-wide. Scientific researchers often do not have direct access to decision-makers. We work with other environmental organizations, the National Park Service, UCLA, and government officials and politicians to raise awareness and to take action to reduce or illuminate the use of the poisons. Our most effective tool is translating the scientific research to language that is understandable and impressive to the public. We will describe our efforts to create effective action and go over lessons learned.

3. Communication and education

All the News That's Fit to Print: How to Get Your Research Covered by Media

Kate Kuykendall[1], and Zach Behrens[2]

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Whether your research subject has an image problem or you just can't get the public (or funders!) to care about your work, strong and compelling images may be able to help. Public engagement is driven by strong images and good storytelling. And (mostly) good things happen when the public actually cares about your research -- your work will be more likely to influence decision-makers, drive positive behavior change, and even attract funding. This session will focus on what makes an image compelling, how to get compelling images, and how to deploy them once you've got them. There will be a special tangent on why you should invest in good graphics rather than that super complicated chart in your PowerPoint that nobody understands except other researchers!

Engaging urban communities around wildlife conservation: using storytelling to inspire action

Beth Pratt-Bergstrom

National Wildlife Federation, CA

...now, how we feel about an animal affects its survival more than anything that you read about in ecology textbooks. Storytelling matters now. Emotion matters. Our imagination has become an ecological force. Jon Mooallem Science rightly drives and informs conservation. Yet to ensure a future for wildlife, and to engage new and diverse communities in wildlife protection, the science isn't enough—we must capture hearts as well as minds. Many worthy and unique species went extinct because the political or public will wasn't there to save them, despite reams of scientific papers. As a society we have to agree that wild creatures are worth protecting if they are going to endure. Storytelling—working in the realm of the imagination—is a vital part of conservation. The case study of P-22, a lonely cougar who made an extraordinary journey across two major freeways to find a new home in the middle of Los Angeles—serves as a model for the perfect blend of using storytelling to engage an audience to achieve educational and scientific outcomes. His tale has captured the imagination of the world, and his plight has propelled efforts to make a long needed and visionary wildlife crossing a reality. The citizens of Los Angeles have rallied around P-22, who has become a celebrity spokesperson (and teaching tool) for the lack of connectivity. Students across the Los Angeles Unified School district are also learning mountain lion biology, ecosystem connectivity, and other STEM items in the context of his story, as P-22 and the issues surrounding him have become a regular part of the curriculum. This session will discuss how to use storytelling and marketing effectively coupled with the science to engage diverse communities, including school programs, large and small scale events, social media strategies, and PR.

3. Communication and education

Urban Elementary School Garden Importance

Amy Richert Goodall

Geographic Science Program, Integrated Science and Technology Department, James Madison University, Harrisonburg, VA

James Madison University Geographic Science (JMU GS) students implemented a garden at a Harrisonburg, Virginia elementary school during spring 2012 in order to build a living laboratory for urban students and to provide a study site for undergraduate research of insects. Garden plantings were selected based on literature review of native plant species and a poll of elementary student preferences for vegetables, fruits, insects, and birds. After five growing seasons and regrouping on garden management each year, a garden culture has developed between the elementary school and the JMU GS Program. The garden program currently involves collaboration between undergraduate volunteers for garden care and elementary teachers that use the garden for teaching students from over 40 countries of birth. Along with educational benefits about place-based vegetable and fruit growing, the garden also has important implications for insect biodiversity. According to four years of undergraduate research, the school garden has the highest butterfly biodiversity when compared to five other Harrisonburg city green spaces. This presentation summarizes the value of the garden program to the environment and to student learning and career development. Included is an assessment of four years of butterfly surveys conducted by undergraduates, a review of participation by elementary students in garden activities, and an evaluation of the number of undergraduates that have changed their career paths as a result of their work in the garden.

Tree Care for Wildlife

Corey Bassett[1] and Magen Shaw[2]

[1]West Coast Arborist, Anaheim, CA; [2]Davey Resource Group, Oceanside, CA

Tree care and landscape activities have the potential to temporarily or permanently impact wildlife. While many tree care workers and managers wish to act responsibly around wildlife, little information has been available about how work can best be accomplished with minimal or no negative impact to wildlife. In addition, the existence of Federal and California wildlife regulations are not widely known within the tree care industry, thereby putting uninformed workers at risk of significant fines and public criticism. The arboriculture and wildlife communities in southern California have been working together since 2015 to develop Best Management Practices (BMPs) to enhance habitat and protect wildlife through tree care practices. The Tree Care for Birds and other Wildlife Project participants included more than 80 arborists, birders, agency staff, and experts in bird nesting biology and habitats, wildlife regulations, arboriculture, and urban forestry. Best Management Practices were drafted that provide guidance to the tree care and landscape industry about how to avoid direct and indirect harm to wildlife, and how to manage situations in which work activities potentially conflict with laws. They will set the standards for specialized training and certification of tree care specialists in California, and for municipal regulations of urban forest management. The wider purpose of this project is to educate tree care providers on using their work to protect wildlife. One of the important values of trees in urban areas is providing habitat for wildlife. Because of habitat loss due to development, urban forests are more vital than ever to wildlife. When trees are managed to support wildlife, urban forests are more diverse and ecologically richer overall. Knowledge of breeding, nesting and foraging habits of wildlife can empower tree care providers to positively impact habitat and encourage the enjoyment of wildlife. The Tree Care for Birds and other Wildlife Project aims to help professionals make better informed choices that will assist workers in following federal, state and local wildlife laws and promote better relations with conservation groups.

3. Communication and education

Bringing Birds Back to Baltimore: A Case Study in Urban Conservation, Education & Community Partnerships

Avalon Mehta Bristow and Holly Shields

National Wildlife Federation, Annapolis, MD

For over 40 years the National Wildlife Federation (NWF), through its Certified Wildlife Habitat (CWH) program, has engaged homeowners, businesses, schools, places of worship, and others in creating wildlife-friendly landscapes on their properties. In 2013, NWF began working in Baltimore by partnering with places of worship to create wildlife habitat in the Reservoir Hill and McElderry Park neighborhoods. We constructed rain and pollinator gardens, bio-retention swales, and an alley gating project with support from local partners and neighborhood residents, who helped shape the design based on unique community needs. We continued our work by partnering with the Maryland Stadium Authority and the Baltimore Orioles Baseball Team to install a showcase wildlife garden at their home stadium, Oriole Park at Camden Yards. The Oriole Garden houses 13,000 native plants that attract butterflies, bees and birds, including the Baltimore oriole. NWF approached our work in Baltimore with the goal of becoming the largest Certified CWH in the Chesapeake Bay watershed, but we quickly realized that receiving a Certification was not the primary driver for community engagement. Rather, residents were motivated by a sense of neighborhood pride, a desire for beautification and decreased trash, reduced nuisance flooding, and improved local water quality. Inspired by our lessons-learned and successes in these communities, NWF is deepening its work with Baltimore residents and partners through an intentional focus on schools and neighborhoods within the Gwynns Falls watershed. Over the next two years, we are creating a large habitat corridor adjacent to the country's second largest urban forest, that connects wildlife habitat and its benefits back to residents of Baltimore's south and southwest neighborhoods. By engaging community members upfront around urban wildlife habitat, NWF is building a network of environmental stewards who understand the value of clean stormwater runoff and native green space in their communities.

4. Human-wildlife interactions

Little Red Riding Hood and the shooting permission: Conflicts between humans and urban wildlife in Europe – political debate and legal management of the increasing wolf population

Judith Wachinger

Viadrina European University, Frankfurt (Oder), Germany

This presentation is about how (A) within a period of 15 years, after an absence of100 years,the wolf has returned to Germany (B) the public and scientific debate has shifted on several levels (C) with wolves being a major element in European Cultural History, management strategies and legal consideration are not confined to property damage vs. wildlife protection, but have to take into consideration a variety of strong cultural and external aspects in a complex multi-interest field. Current situation: The wolf population in Germany has significantly increased in recent years. After the systematic eradication of wolves which had started in the middle ages, the last wolf in Germany was killed in 1904. During the 20th century, wolves from Poland occasionally crossed the German-Polish border, but it was not until 2000 that a pack settled in Germany and reproduced. As of January 21, 2017, there are 69 known packs consisting of an average of 8 wolves, plus 15 couples, plus numerous loners. Causes, Consequences and Wolf Management Strategies: Germany is a very densely populated country, covering an area of 137,903 square miles. Being located in the center of Europe, consisting of 16 federal states and sharing borders with 9 countries, Germany is a characteristic example for habitat management facing migratory behavior of animals crossing both state and international borders. With a wolf's territorial range of typically 120 to 190 square miles, rural and urban areas are always concerned. Since 2015, wolves have started roaming suburbs and towns, rising resentment among urban population, whereas between 2000 and 2015 the debate had focused on wolves killing farm animals. Measurements taken by the German and European Administration, such as compensation of damages, specific shooting permissions and financial aids forthe purchase and training of sheep dogs, will be discussed.

4. Human-wildlife interactions

How wild animals respond to human activity: Developmental processes shaping responses to anthropogenic activity in an African carnivore

Julia R. Greenberg, Julie W. Turner, Zach M. Laubach, and Kay E. Holeka

Michigan State University, East Lansing, MI

Wildlife can alter their behavior in responseto increased human activity remarkably rapidly; however, we often lack an understanding of the mechanisms that underlie these anthropogeniceffects. To investigate the developmental mechanisms that shape responses to human activity, we studied juvenile wild spotted hyenas living in two areas of the Mara-Serengeti ecosystem in Kenya: pristine undisturbed habitat in the Mara Conservancy and habitat heavily disturbed by human activity near a fast-growing town on the border of the Masai Mara National Reserve, whereeffects of human activity on the behavior and physiology of adult hyenas have previously been documented. Juvenile spotted hyenas spend their early livesexclusively at communal dens,where they are largely buffered from the surrounding environment. However, our studies show that,even early in life, there ismarked variation in hyenas' temperaments,and life-history patterns,depending on the degree of human disturbance in their environment.This raises the question of how young hyenas can show these responses with relatively little direct exposure to human activity. We go on totest hypotheses suggesting that maternal behavior or stress physiology are mediating these anthropogenic effects in young den-dwelling hyenas. We conclude by offering ideas about how an understanding of the mechanisms mediating anthropogenic effects can help us to predict the effects of human activity on wild populations, and to improve management strategies aimed at preventing or changing behaviors that bring wildlife into c

Wildlife Habitat Mitigation at DFW Airport: balancing safety and stewardship

Cathy Boyles, Wildlife Administrator, Dallas/Fort Worth International Airport, PO Box 619428, DFW Airport, TX 75261 USA (cboyles@dfwairport.com) 972.973.3122

Wildlife populations have challenged aviation since the age of the Wright brothers. The first recorded wildlife strike (strike) occurred in 1905 when Orville Wright struck a bird over an Ohio cornfield. The first strike fatality occurred 7 years later, when the plane flown by Calbraith Rodgers struck a flock of gulls, causing the aircraft to crash, killing the aviation pioneer. Since then a number of factors have led to an increase in strikes globally: technological advances have made aircraft quieter and less detectable by wildlife on the ground or in the air; transportation demands have increased numbers of flight operations worldwide over the years; and environmental concerns have resulted in protection laws and habitat management to accommodate declining bird species that successfully increased population sizes, especially of some of our largest and potentially most damaging bird species-- waterfowl (which includes ducks and geese) and raptors-- and flocking birds (blackbirds). Consequently, the potential for aircraft and wildlife to occupy the same space has increased. Military and civil aviation have responded to heightened awareness of the challenges posed to aviation safety through formalized mandates. All CFR Part 139 airports are required by the Federal Aviation Administration (FAA) to conduct a formal Wildlife Hazard Assessment administered by a Qualified Airport Wildlife Biologist and respond to hazards and attractants through Wildlife Hazard Management Plans, and many General Aviation airports are implementing wildlife mitigation strategies. While all airports are different and deal with a wide variety of wildlife challenges due to geographic location and surrounding habitat, they all rely on some basic strategic and tactical tools to address these challenges. This talk will focus on these tools, with special emphasis on strategies employed at DFW Airport.

4. Human-wildlife interactions

Managing leopard *(Panthera pardus*) population in human modified landscape in Himalayas: - Is it possible?

D. Chauhan and S.P. Goyal

Wildlife Institute of India

The leopard is widely distributed in India and survived from its ability to adapt a variety of environmental situations in and outside Protected Areas but lacking effective conservation strategies. Increase in Leopard-human conflicts has been noticed more in Himalayas due to habitat fragmentation, degradation and decline in wild prey. We studied ecological and biological requirements of leopards in human modified landscape of Himalayas to provide better conservation of species. Pauri Garhwal district (5444 km^2) is worst affected due to leopard-human conflicts among thirteen districts of Uttaranchal. During 1987-2002, 200 people were killed by leopards where as 110 leopards were killed as declared man-eater and by irate villagers. We classified areas in four categories based on severity of conflicts viz. no (29.5%), low (23.9%), medium (31.4%) and high (15.2%) of conflict. We found that leopards are targeting soft preys such as children and 69% victims were children below 15 years. Most of these kills (68%) were between 1600-2100 hrs. We noticed more conflicts in areas of high forest degradation and dominated by shrubs. Other factors responsible for conflicts are presence of dog, no electricity, distance of house from main village and presence of adult males. We discussed mitigatory measures to reduce conflicts.

Endangered Manatees, Humans, and Crystal River National Wildlife Refuge, Florida: A Gordian Knot

Rae Ellen Syverson and Carl Wolfe

U.S. Fish and Wildlife Service, Crystal River National Wildlife Refuge Volunteer Scientists

The endangered manatee is at the center of a wildlife dilemma involving people who want to swim with manatees, local and federal government, and the tourism industry. A unique ecosystem in Crystal River and Kings Bay, Florida provides warm spring-fed water year around. Manatees are cold intolerant. When the water in the Gulf of Mexico falls below 68°F they seek out warmer waters. One such place is Three Sisters Springs in Crystal River. These springs are in a 78 acre undeveloped tract owned by the city of Crystal River and Southwest Florida Water Management District and managed by the Crystal River National Wildlife Refuge. The economy of Crystal River is largely dependent on the tourism industry based on manatees. Three Sisters Springs is a favored place for swimming with manatees. A two-year study was completed in 2016 with more than 350 hours of monitoring by USFWS volunteers and interns. The study evaluated manatee usage of the Springs and the effect of in-water tourism on the manatees. Many more manatees were found to use the Springs than had been previously estimated. The study documented frequent crowding of manatees, swimmers and paddlecraft in the only passage between the Springs and Kings Bay. Many swimmers respected the manatees and followed manatee viewing guidelines. However, numerous examples of harassment of manatees were observed in direct violation of the Endangered Species and Marine Mammal Acts. We will discuss the research, its relationship to the many stakeholders in the community, and its impact on management of the Springs.

Urban Rookery Management: Texas Case Studies

Rachel Richter

Texas Parks and Wildlife Department, Fort Worth, TX

When a breeding colony of herons and egrets, known as a rookery, takes up residence in an urban area, there is often human-wildlife conflict. Large numbers of the birds resultin unwanted noise and piles of waste, causing a serious nuisance. The colonies are protected by the Migratory Bird Treaty Act, which complicates attempts to remove the birds. Natural resource managers have found that proactive collaborations betweengovernment organizationsand citizenscandeter the establishment of rookeries.This presentation will discusscase studies fromurban areas inTexas and effective techniques for encouraging herons and egrets to select more suitable nesting sites.

4. Human-wildlife interactions

The seasons and places of encounter: Analyzing human-squirrel encounters in Toronto

Tracy L. Timmins and Justin J. Podur

Faculty of Environmental Studies, York University, Toronto, Canada

In this paper, we examine human encounters with eastern gray squirrels (*Sciurus carolinensis*) in Toronto, Canada. Squirrels, like the subject of our ongoing work on raccoons, are both appreciated by many urban residents and frequently regarded as nuisance animals due to their propensity to build nests in people's roofs and attics or disturb garden beds. In addition, they comprise the most commonly mentioned mammal species in hotline calls to The Toronto Wildlife Centre, an animal hospital and rehabilitation centre. We examine two types of encounters: those with sick, injured and orphaned animals, and encounters with animals who take up residence in people's homes. We do so using data from the Toronto Wildlife Centre and AAA Gates Wildlife Control, a humane animal control company, for the years 2000 to 2013. The aim of this research is to understand when, where, and why humans and squirrels encounter each other by looking at the months, seasons, places and circumstances of encounters, as well as the age and sex of animals, when available. In addition, we test encounters for spatial clustering using Ripley's K function and local indicators of spatial association, as well as test for spatial association with landscape variables including housing density and percentage tree cover. Finally, encounter patterns are related to eastern gray squirrels' life history, ecological, and behavioural characteristics, as well as human activity and housing patterns. This analysis provides us with an increased understanding of how people and synanthropic wildlife species such as eastern gray squirrels interact with each other. These findings will assist in developing recommendations to support human-wildlife coexistence in urban areas.

Human Dimensions: Raptor-human Conflict in Urban Settings

Brian E. Washburn

U.S. Department of Agriculture/APHIS/Wildlife Services National Wildlife Research Center, 6100 Columbus Avenue, Sandusky, OH 44870 USA

Traditionally, raptors such as bald eagles, ospreys, and barred owls were thought of as wilderness-inhabiting species. However, due to the amazing plasticity these bird exhibit in regard to their habitat use patterns, during recent years these species are commonly found in high abundance in suburban and very urban settings. These changes in habitat use patterns result in considerable interactions between humans and urban raptors. Although there are clearly positive aspects of these frequent human-raptor interactions (such as environmental education opportunities and increased contact with the natural world by urbanites), a diversity of raptor-human conflicts has also resulted from the presence and abundance of urban dwelling raptors. This presentation will provide numerous examples of raptor-human conflicts that occur in urban ecosystems, including situations that involve human health and safety issues, economic impacts of varying degrees, and other problems. As human populations continue to grow and urbanization spreads across many landscapes, the frequency and complexity of these issues will only increase during the coming years. Lastly, management and mit igation options will be discussed that are focused on alleviating these raptor-human conflicts to minimize impacts and maximize benefits to both people and birds.

What's old is new again: Cost-effective management of human-beaver conflicts

Glynnis A. Hood, and Varghese Manaloo

University of Alberta, Augustana, Camrose, Alberta

Human-wildlife conflicts result in ongoing and costly management by all levels of government. We installed and evaluated 12 pond-levelers to counter flooding by beavers and developed a cost-benefit analysis for these sites in a protected area in Alberta, Canada. We also documented beaver management approaches in municipalities throughout Alberta. Over three years, one pond-leveler site required regular maintenance until we designed a modified pond-leveler; another required minor modifications, and the remaining 10 sites required little to no maintenance. Installing 12 pond-levelers resulted in a present value (PV) net benefit of $2,680,640 after only three years. A sensitivity analysis, without the contingent valuation included, still resulted in an $81,519 PV net benefit. Municipalities employed up to seven methods to control beavers: with the most common being lethal control and dam removal. Total annual costs for beaver management provided by 48 municipalities and four provincial park districts was $3,139,223; however, cost-accounting was sometimes incomplete which makes this a conservative estimate. This research has led to further installations and research in a nearby rural municipality (14 pond-levelers) and the city of Camrose, Alberta (2 pond-levelers), where we have seen similar results. Alternative management approaches can provide cost-effective and long-term solutions to human-beaver conflicts in rural and urban areas.

5. Challenges and opportunities managing and monitoring wildlife across conservation plans in the South Coast Ecoregion of Southern California

Overview of Conservation Planning in the South Coast Ecoregion and the Challenges and Opportunities for Regional Collaboration

Keith Greer[1], Susan Wynn[2], and Hans Si[3]

[1]San Diego Association of Governments, San Diego, CA; [2]U.S. Fish and Wildlife Service, Carlsbad, CA; [3]California Department of Fish and Wildlife, San Diego, CA

California is a biodiversity hotspot, with more endangered, threatened and rare species than inany other state. In the rapidly urbanizing areas of San Diego, Riverside, and Orange Counties, local jurisdictions have partnered with the wildlife agencies to develop and implement large-scale Natural Community Conservation Planning (NCCP) programs to protect, manage, and monitor sensitive plant and animal species and vegetation communities. Land acquisition, management, and monitoring in each plan area is well underway and there are now opportunities for collaborations across plan boundaries to provide efficiencies in implementation and to collect data at a regional scale to better inform management. This presentation will provide an overview of the plan areas in the South Coast Ecoregion, regulatory framework, species and vegetation communities conserved, and the challenges of scaling up monitoring and management to the ecoregion scale.

Management and Monitoring Strategic Plan (MSP) for Conserved Lands in Western San Diego County and the MSP Portal

Yvonne Moore[1], Kris Preston[1], Trish Smith[1], Emily Perkins[1], Sarah McCutcheon[1], Annabelle Bernabe[1], Brenda McMillan[1], Donn Holmes[2], Dam Nguyen[2], Curtis Tamanaha[2], and Elise Watson[2]

[1]U.S. Geological Survey, Western Ecological Research Center, San Diego Management and Monitoring Program, [2]U.S. Geological Survey, Western Ecological Research Center, San Diego, CA

The San Diego Management and Monitoring Program (SDMMP) is a science based program that provides a coordinated approach to management and biological monitoring of lands in San Diego that have been conserved through various conservation programs and mitigation efforts. The SDMMP was tasked with preparing a regional management and monitoring plan that fulfills the need for a strategic approach to implement management and monitoring objectives in a cost-effective manner. The Management and Monitoring Strategic Plan for Conserved Lands in Western San Diego County: A Strategic Habitat Conservation Roadmap (or simply MSP Roadmap or MSP) is a comprehensive, landscape-scale adaptive management and monitoring framework for prioritized species and vegetation communities in western San Diego County. By establishing biological goals and measurable objectives across the region, the MSP Roadmap provides for a coordinated effort among multiple key organizations in western San Diego County in the implementation of adaptive management and monitoring actions using the same approach. The MSP Roadmap categorizes and prioritizes plant and animal species, vegetation communities, and threats/stressors, identifies geographic locations for actions, provides specific timelines for implementation, and establishes a process for coordination and implementation. The MSP Roadmap includes databases and mapping tools (MSP Portal) which are available on the SDMMP interactive website: http://portal.sdmmp.com. This presentation will provide an overview of the MSP Roadmap, the collaborative tools developed and available on the MSP Portal, and the efforts to bring partners together to develop and implement monitoring and management projects across the region.

5. Challenges and opportunities managing and monitoring wildlife across conservation plans in the South Coast Ecoregion of Southern California

Beyond NCCPs: Developing Strategies to Ensure Regional Wildlife Connectivity in Southern California

Trish Smith and Cara Lacey

The Nature Conservancy, San Diego, CA

Southwestern California is the birthplace of the State of California's Natural Community Conservation Program (NCCP), established in the early 1990's to protect habitats and species at the subregional level while allowing compatible development to continue. Today, five of the thirteen NCCPs approved statewide are in place in the contiguous counties of Orange, Riverside and San Diego, with additional plans proposed or in the planning process. Despite the progress that has been made through the NCCPs to conserve and managetheregion's wildlife habitat, gaps in the conservation reserve networks approved under the plansremain, that if developed, could threaten the persistence of many species, particularly those that need to move in response to many threats, including climate change. Gaps in habitat connectivity between core protected areas are particularly concerning. Although such connectivity was included in the plans' reserve designs, these connections have not been given specific focus or priority. This presentation will identify potential strategies and tools for addressing wildlife connectivity at the regional level, building upon the framework established by the NCCP.

Regional Occupancy and Post-fire Recovery of California Gnatcatchers in Southern California

Barbara E. Kus, Kris L. Preston, and Alexandra Houston

U.S. Geological Survey, Western Ecological Research Center

The California Gnatcatcher, a federally threatened species, is the flagship species for regionalconservation planning in southern California. An inhabitant of coastal sage scrub vegetation, the gnatcatcher has declined in response to habitat loss and fragmentation, and the population now exists in small patches within an urban matrix. Exacerbating loss of habitat to development, catastrophic wildfires have emerged recently as the largest threat to persistence of California Gnatcatchers throughout their range. We undertook two inter-related investigations to examine post-fire recovery of gnatcatchers and their habitat, and to document the status of gnatcatchers throughout their California range to establish a baseline from which future population trends could be derived. We used GIS to develop a habitat suitability model for California Gnatcatchers using PRISM (climate, topography) covariates, and selected over 700 points in a spatially balanced manner on conserved lands and participating military lands. Bird and vegetation data were collected at each point between March and May in 2015 and 2016. Presence/absence of gnatcatchers was determined on each of three visits to points, using area searches within 150 x 150 m plots. We used an occupancy framework to generate Percent Area Occupied (PAO) by gnatcatchers, and analyzed PAO as a function of time since fire. At the regional scale in 2016, 23% of the points surveyed were occupied by gnatcatchers, reflecting in part the effect of massive wildfires in the last 15 years. Similarly, PAO in the post-fire subset of points was 24%, with the highest occupancy in unburned (last fire <2002) habitat. Among points that had burned since 2003, occupancy increased with time since burn, but sites that burned in 2003 have still not achieved the PAO of unburned sites. Thus, identifying management to accelerate post-fire recovery of coastal sage scrub is a high priority for habitat and species conservation.

5. Challenges and opportunities managing and monitoring wildlife across conservation plans in the South Coast Ecoregion of Southern California

Conserving Coastal Cactus Wrens: A Fragmentation Sensitive Species Facing Multiple Threats in an Urbanized Landscape

Kris L. Preston[1], Barbara E. Kus[1], Dana Kamada[1], Karly Moore[1], Trish Smith[2], and Milan Mitrovich[3]

[1]U.S. Geological Survey, Western Ecological Research Center; [2]The Nature Conservancy, California; [3]Natural Communities Coalition, Irvine, CA

Cactus wrens have significantly declined in coastal southern California due to habitat loss and fragmentation from urban development. Wrens are conserved by multiple species conservation plans but continue to decline due to large-scale wildfires and drought. Productivity is positively associated with late winter-early spring rainfall, late winter minimum temperatures and early egg laying. Egg laying is initiated earlier in years with warmer March temperatures, in pairs with older males, and at sites with lower wren territory densities and fewer corvids. Reproduction appears limited by food availability. Survival from fledging to adulthood is low. Most individuals are sedentary, staying close to natal sites with limited dispersal in fragmented landscapes.Predation can be high in urban fragments and small populations (<3-5 pairs) are vulnerable to local extinction. Active management is required to recover populations from the effects of urbanization, wildfire and drought. The management strategy is focused on restoring and enhancing habitat to enlarge existing wren populations and restoring connectivity via large stepping stone patches of live-in habitat for multiple wren territories. Research is underway to determine cactus restoration planting palettes that support arthropods fed to nestlings and identifying planting microhabitats that provide greater plant and arthropod resilience to drought. A wildfire management strategy includes establishing cactus nurseries and cactus outplantings to provide source plants for immediate post-fire habitat rehabilitation, reducing fire ignitions, decreasing fire severity in cactus patches, and maintaining populations in fire refugia to provide a source of wrens to recolonize sites burned in wildfires. Management to prevent loss of genetic diversity and inbreeding may be necessary. Adults have been successfully translocated between sites to augment populations and enhance genetic diversity, although it is expensive and there is a lack of donor sites. Swapping eggs between nesting pairs may be a more feasible alternative for enhancing genetic diversity.

Biotelemetry Data for Golden Eagles (*Aquila chrysaetos*) Captured in Coastal Southern California, November 2014–February 2016

Robert N. Fisher[1], Jeff A. Tracey[1], Melanie C. Madden[1], Jeremy B. Sebes[1], Todd E. Katzner[1], and Peter H. Bloom[2]

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The status of golden eagles (*Aquila chrysaetos*) in coastal southern California is unclear. To address this knowledge gap, the U.S. Geological Survey (USGS) in collaboration with local, State, and other Federal agencies began a multiyear survey and tracking program of golden eagles to address questions regarding habitat use, movement behavior, nest occupancy, genetic population structure, and human impacts on eagles. Golden eagle trapping and tracking efforts began in October 2014 and continued until early March 2015. During the first trapping season that focused on San Diego County, we captured 13 golden eagles (8 females and 5 males). During the second trapping season that began in November 2015, we focused on trapping sites in San Diego, Orange, and western Riverside Counties. By February 23, 2016, we captured an additional 14 golden eagles (7 females and 7 males). Biotelemetry data were collected between November 22, 2014, and February 23, 2016. The location data for eagles ranged as far north as San Luis Obispo, California, and as far south as La Paz, Baja California, Mexico. This presentation will provide an overview and results from the study.

5. Challenges and opportunities managing and monitoring wildlife across conservation plans in the South Coast Ecoregion of Southern California

Recreation Management and Human Valuation, the Fusion of Social and Ecological Sciences

Milan Mitrovich[1], and Chris Monz[2]

[1]Natural Communities Coalition, Irvine, CA; [2]Utah State University, Logan, UT

Managers of urban-proximate wildland settings must often strike a careful balance with providing nature-based recreation experiences with the maintenance of ecological integrity. With over 3 million residents within a 30-minute drive of the natural areas of central and coastal Orange County, the demand for recreation experiences is ever present, and increasing. Equally important is the increasing need and desire for the conservation of natural resources and preservation of the rich natural heritage of an iconic area of the California coast. Resource management planning and implementation strategies in natural areas are often more successful when informed by interdisciplinary research that combines both ecological and social science approaches in a location specific manner. The Natural Communities Coalition has partnered with national leaders in the field of recreation ecology from Utah State University and Oregon State University to implement a multi-year project designed to address ecological aspects, human benefits and values, and contemporary management approaches tied to recreation within the region. Fourteen management units within the Nature Reserve of Orange County are considered a high priority for assessment and monitoring of recreation use and associated management uses. The majority of units fall under the management of OC Parks, California State Parks, and the Irvine Ranch Conservancy. The project will employ both continuous assessment and sampling approaches to establish baselines conditions. Work is to include field assessment of the location and condition of trails, sites, and other areas of visitor use, determination of the spatial distribution of use, and assessment of visitor attributes and preferences, demographics, motivations, values and judgements of resource and social conditions. Work will be conducted in two distinct phases. The first phase is three years in duration, with social and biophysical field sampling to begin spring 2017.

Accessibility Drives Species Exposure to Recreation in the Urbanized Coastal San Diego County Reserve Network

Courtney L. Larson[1], Sarah E. Reed[2], Adina M. Merenlender[3], and Kevin R. Crooks[4]

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Most protected areas globally have a dual mandate that includes both biodiversity conservation and providing access for outdoor recreation. In urban areas, there is often particularly high demand for access to remnant natural spaces. Despite its numerous benefits for humancommunities, recreation can have negative effects on animal species. Our recent global systematic review found that 93% of scientific papers on this topic found at least one significant effect of recreation on wildlife, demonstrating that there is a clear need to understand patterns of recreational use and resulting threats to sensitive species. We quantified spatial and temporal variability in recreation across a network of reserves in the urbanized, yet biodiverse landscape of coastal San Diego County. Visitation rates varied widely, and we found that accessibility variables such as the number of parking lots, entrances, and nearby housing units had the strongest relationships with visitation, rather than reserve characteristics such as area or vegetation communities. We also identified several species that we expect are exposed to high levels of recreational use, including the orange-throated whiptail (*Aspidoscelis hyperythra*), western spadefoot (*Spea hammondii*), and the federally-threatened California gnatcatcher (*Polioptila californica californica*). Our results can be used to prioritize highly exposed species for further research into their responses to recreation, as well as identify areas with potential conflicts between recreation and conservation objectives as priorities for management.

5. Challenges and opportunities managing and monitoring wildlife across conservation plans in the South Coast Ecoregion of Southern California

Managing Threats on Local Reserves Surrounded by the Urban Landscape

Betsy Miller

City of San Diego, San Diego, CA

Land managers have extensive experience managing anthropogenic threats to natural resources on conserved lands in the urban fragments in western San Diego County. Examples of the multitude of threats to conserved plant and animal species and ecosystem functions include invasive nonnative plant and animal species, recreation, illegal dumping, altered hydrology, trampling, homeless encampments, pollution, pesticides, and encroaching land uses. Land managers must also deal with larger-scale processes that can impact natural communities such as wildfire and drought. Land managers rely an adaptive monitoring and management approach, with monitoring targeted to identify management needs and the effectiveness of management actions. A management oriented monitoring program is essential in persuading decision makers to allocate funding for recommended management. Land managers benefit from science that increases understanding of the system being managed and on determination of best management practices. To optimize management of conserved lands, land managers need flexibility to respond to circumstances on the ground and trust from decision makers and regulatory agencies that they have the expertise to effectively manage threats. There are many roadblocks and challenges to successful management and land managers rely on science,practical expertise and lessons learned to navigate these obstacles.

Local Efforts to Manage Shot-Hole Borer/Fusarium Complex Impacting Wildlife Due to Mass Tree Mortality

Keith Greer[1], Kyle Rice[1], and Gail Sevrens[2]

[1]San Diego Association of Governments; [2]California Department of Fish and Wildlife

An invasive ambrosia (aka “shot-hole”) beetle was recently discovered in southern California in stands of native and ornamental tree species and is known to cause severe damage to riparian communities and urban areas. The shot-hole beetle forms a symbiotic relationship with the *Fusarium* spp. fungus it carries. The potential for this pest species to cause large amounts of destruction has already been realized. Within the Tijuana River Valley, more than 280,000 trees have been infested by the shot-hole beetle, and more than 140,000 trees have suffered major limb damage throughout 241 hectares (597 acres) of primarily riparian forest. This stretch of river serves as vital breeding ground for the state and federally endangered least Bell’s vireo, magnifying the implications of this loss. It is likely that this will not be an isolated event and further damage of critical, native habitat can be expected in the future if methods to control the beetle are not developed. Due to the species’ extensive list of suitable reproductive host trees and the survivability of the fungus and beetle throughout a wide range of temperatures, there is nothing that suggests this pest species will not become more than a regional issue and spread statewide, potentially into other parts of the country. This presentation will provide an overview of local efforts to develop and implement a management strategy aimed at limiting the expansion of the species and to prioritize investment for a long-term solution. This effort requires coordination across jurisdictional boundaries, industries, interest groups, and disciplines (*i.e*. entomology, plant pathology *etc*.) making it a considerable task to undertake. However, such an effort is required if further losses of critical habitat are to be prevented.

6. Citizen science

Parrots and People: Using Citizen Science to Conserve the Globally Endangered Red-crowned Parrot

Anthony K. Henehan, Cliff Shackelford, and Cullen Hanks

Texas Parks and Wildlife Department, McAllen, TX

The Red-crowned Parrot (*Amazona viridigenalis*) is an IUCN endangered species of parrot native to northeastern Mexico and Deep South Texas. Current population estimates list the species at < 2000 individuals and declining. Main threats to the parrot include habitat loss due to rapid urbanization and collection for the pet trade in Mexico. A substantial population of parrots exist in the heavily urbanized Rio Grande Valley of Texas from McAllen to Brownsville. We initiated a Valley-wide survey effort in January 2016 to better understand the size of the population of Red-crowned Parrots in Texas. First, we mapped known roost locations using observations from Ebird.org. Then, utilizing iNaturalist and collaborative opportunities with citizen scientists and conservation organizations such as the Arroyo Colorado Audubon Society, we conducted quarterly roost surveys during 2016 with as many as 71 volunteers assisting. We also had 2 biologists from Mexico assist and learn about our monitoring efforts. We utilized community engagement as the best survey method because of the need for multiple observers at each roost location and the knowledge of parrot locations from local observers. Observers were assigned locations in McAllen, Weslaco, Harlingen, and Brownsville. Surveys began 1 hour before sunset to dark. Observers counted all parrots seen. During the winter, we estimated 650 parrots at 4 known roost sites in Cameron and Hidalgo counties, but due to seasonal abundance changes our estimate dropped to 300 in summer when breeding pairs break away from communal roosts in order to raise their young. We will continue monitoring the population of parrots in Texas due to the success of our initial efforts. Our surveys are contributing directly to other research projects on the ecology of the Red-crowned Parrot including nesting ecology and population demographics. We recognize the importance of the Rio Grande Valley for the continued existence of this species.

Crowd-sourcing data collection to facilitate understanding of actual versus opportunistically observed range of urban and suburban coyotes (*Canis latrans*)

Kelly Conrad Simon[1], Amy Belaire[2], and Travis Gallo[3]

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The City of Austin, Texas and Travis County, Texas have historically collected and mapped observations of coyotes through a 311 telephone reporting system. Observations were opportunistic and depended on the availability and identification skill of untrained observers. These observations helped drive wildlife management decisions by contracted professionals. However, opportunistic observations may not provide an accurate representation of the actual distribution and movement of coyotes. Further, by restricting data to opportunistic observations we have limited knowledge of the potential relationships between Central Texas urbanization, habitat fragmentation, roadway density, and nocturnal lighting and coyote distribution and activity. While the adaptability and relatively recent expansion of coyotes into urban areas suggests that behavioral and physical adaptations might vary greatly among sites, published studies of urban coyotes have been restricted to two main study sites: Chicago, IL and Ventura County, CATo gain a more accurate understanding of Central Texas urban coyote distribution and natural history, Texas Parks and Wildlife Department and the Urban Wildlife Institute partnered with the City of Austin and Wild Basin Creative Research Center to conduct an extensive survey of urban meso-mammals, including coyotes, using game cameras spaced along a gradient from intensely urban to rural habitat in Austin, Texas. The anticipated large data set creates an opportunity for citizens to participate by identifying wildlife and other subjects using a protocol developed by the Urban Wildlife Institute. Researchers will also examine the effects of additional variables including vegetation, road density, urbanization, fragmentation, light pollution, temperature, and human activity at the camera trap site. Researchers anticipate that this more comprehensive data set will provide greater insight to actual coyote distribution, abundance, and activity, and will provide better information for wildlife management decision-making. Additionally, the contributions of the public through the crowd-sourced data interpretation functions to connect urban residents to wildlife, hopefully making this research and its results more relevant and valuable to participants.

6. Citizen science

Balancing the Education & Scientific Goals of Urban Biodiversity Focused Citizen Science Projects

Lila Higgins, Richard Smart, Miguel Ordeñana, and Greg Pauly

Natural History Museum of Los Angeles County, Los Angeles, CA

Citizen science is sweeping the nation and its science education institutions. With its focus on answering real world questions and engaging volunteers in that process, citizen science straddles the fields of education and science. But how do you balance the two? The Natural History Museum of Los Angeles County has been engaging audiences in urban citizen science projects since the California Parrot Project in the early 1990s before e-mail, smartphones, and mobile apps were tools at our disposal. Over the last decade the Museum has expanded its urban biodiversity research efforts with citizen science as the primary mode of both data collection and publicengagement. We have widened the reach—geographically and demographically—and begun employing web and mobile technologies. By hiring citizen science practitioners with expertise in the field and knowledge of best practices, the Museum has been able to support new research projects with an aim to better facilitate collection of quality data and participant learning. Strong partnerships have been built between research scientists and educators, so projects can be developed with both scientific and education goals in mind. To measure the success of our efforts, we collect evaluation data from participants involved in our programs. We have a number of published papers documenting the research and education outcomes, and are contributing to furthering best practices in the field through further publications, training webinars, and professional presentations.

The otters and otter watchers of Singapore

Philip Johns

Yale-NUS College, Singapore

Smooth-coated otters (*Lutrogale perspicillata*) returned to Singapore a few years ago in response to improving water conditions. An extremely active group of enthusiasts has been following the otters almost daily. Technology and online conventions have grown to the point where people are collecting a large quantity of high quality behavioral data, sometimes without being aware of that. This presentation discusses the Singapore otters as a case study in the role of community and technology in generating usable data — especially behavioural data — and presents preliminary behavioral analysis of Singapore otters, including social interactions between adults and pups, otter-monitor lizard interactions, and otter vocalisations. The presentation concludes discussing possible future directions of citizen science in relation tourban wildlife.

6. Citizen science

Making connections through nature investigation plus integration: Project NIPI

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Project NIPI, Nature Investigation Plus Integration, aims to provide context for students through their own investigation of their surroundings, and increasing awareness of the natural phenomena they can observe from their own school. Project NIPI is rapidly evolving from the Mon Paysage Sonore/My Soundscape initiative in Quebec, but has its roots in work started in the 1990's at Compton Community College introducing adult learners to science. Basic skills students, many still struggling readers, were introduced to LANDSAT imagery that included both their school and the ocean to provide context for their geography map test. They learned the compass directions, and were asked to document the directions their kitchen windows faced, or in the case of a student with no access to a kitchen, the nearest coffee shop window. Students observed and asked questions about a passing butterfly migration while outside observing the moon during class. When asked during the final, "What did you learn in class that will help you in the future?", almost half the students mentioned this supplementary course material. This year, with the support of a Wildlife Acoustics equipment grant, primary school students at École Étoile filante in Montréal, Quebec have formed a new partnership with Kullik Ilihakvik in Cambridge Bay, Nunavut to record the soundscapes around their schools. We renamed our project nipi, using the Innuinaqtun word for sound. Using soundscape investigation as our central tool, students are finding ways to exchange observations and integrate their knowledge. Third and fourth graders used their parents smartphones and two school iPads equipped with Song Sleuth to make recordings in their school, community, and across the city of Montréal to investigate their soundscape. They investigated noise pollution, compared biophony, geophony, and anthrophony levels, and created stories using bird sounds they had recorded. By integrating direct scientific observations into schools, the next generation of citizen scientists gains hands-on experience that provides context for understanding not only concepts like biodiversity, but also the implications nature has for urban life.

7. Urban white-tailed deer

Spatial genetic structure of white-tailed deer in urban landscapes: potential for localized management

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Deer-human conflicts in urban landscapes present unique challenges. Dense populations increase the likelihood of encountering disagreement regarding perceptions of management issues and acceptable management practices. Decisions regarding management at the scale of a neighborhood would involve fewer residents with similar interactions with deer. A localized management strategy may be feasible if urban deer exhibit home range fidelity and form matrilineal social groups typical in rural populations because such behaviors may decrease the probability of dispersal into managed areas. We used non-invasive sampling to examine spatial genetic structure among white-tailed deer in a high-density urban population in Meridian Township, Michigan, USA. Our research objectives were to 1) determine if deer in urban-suburban landscapes exhibit social group structure and if so, 2) quantify the landscape context of spatial structuring and neighborhood size for kin groups. We used fecal pellet DNA (n = 591) collected August – October 2013 from public and private lands throughout the study area to identify individuals, assess fine-scale spatial genetic structure, and estimate the spatial extent of related groups. We also evaluated the relationship between landscape features and genetic relationships of deer using an isolation-by-resistance approach. Global spatial genetic correlation was positive and significantly higher than expected up to a distance of 500 m, consistent with the expectation that female deer form matrilineal social groups, however, we did not detect correlations between landscape features and genetic distance. Our results indicate that deer in suburban landscapes retain the social genetic structure reported for rural populations, albeit at a smaller spatial scale and with substantial overlap from other groups. We discuss the implications of the spatial scale over which genetic structuring exists in this landscape and the potential for using landscape features to identify biologically meaningful areas that can be utilized to develop local management strategies at a fine spatial scale.

7. Urban white-tailed deer

Threading the Needles: Paths to Deer Management

Scott Bates

National Capital Region, National Park Service, Washington, DC

A 1999 court ruling stated that the National Park Service (NPS) must use environmental impact statements for deer management instead of the less complicated environmental assessment. Facing this situation, the National Capital Region used sound science to assess deer impacts to park environments and assess deer densities. This data was used to develop environmental impact statements to support deer management. Adaptive management is used in monitoring deer management actions at parks in the region. There are four parks managing deer in the region with two more pending public meetings and administrative review. This presentation will review the steps taken by the region to achieve deer management.

Decision Support for Suburban Deer Management

G. Kent Webb

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Alternatives currently available for suburban deer management are evaluated using case examples and a financial model developed from a daily internet search for relevant information collected over several years. Important findings include: that deer can be relocated at reasonable costs and with good survival rates; that current research and collected data show deer culls are not effective at lowering the risk of Lyme disease except in insular environments; that cost analysis of deer culls typically ignores the significant long-term costs associated with the increased fertility of deer in response to hunting programs that result in a perpetual culling program; that wildlife experts routinely provide widely contradictory advice on what the scientifically determined deer density should be; and, that government resistance to contraceptives has reduced the potential benefits of this alternative which shows promise in suburban environments particularly when lethal approaches are not feasible because of safety or ethical concerns. Also included are the results of a camera survey and volunteer counts of deer in a sterilization project in San Jose, California, where the deer population fell below desired levels after about 3.5 years. An important issue in the cost analysis and evaluation of population control alternatives is the migration rate of deer into the region. In this semi-open environment where sterilized does were free to move in and out of the community, no in-migration was recorded over a four year period. Other collected information supports the expectation of relatively low migration rates. The camera survey in this case also verified that the volunteers did an extremely accurate job of counting the deer as no uncounted deer were discovered. Examples of the usefulness of camera surveys to evaluate wildlife behavior in landscape architecture are also presented.

7. Urban white-tailed deer

Using “FragPatch” to Delineate Urban Deer Habitat Patch Networks in Syracuse, New York

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Urban wildlife species perceive landscape characteristics at multiple spatial scales in response to human disturbance and increased interspersion of resources in highly-developed areas. Areas with high human densities are typically unused by wildlife, but residential and commercial areas with sporadic tree cover are heavily used. We developed a tool to identify hierarchical habitat patch networks for wildlife in urban environments. The tool, FragPatch, uses suitability indices and behavioral responses for a target species to delineate nested patch networks and reveals potential functional connectivity at multiple spatial scales. FragPatch delineates habitat patches after first removing any contiguous areas of unsuitable landcover and is ideal for fragmented or urban environments. We used FragPatch to identify patch networks for urban white-tailed deer in Syracuse, New York. White-tailed deer thrive in urban landscapes, likely due to reduced distances between food, water, and escape cover habitat constituents for deer where land cover and land use are highly interspersed. The networks of habitat patches used as escape cover influence deer space use in fragmented landscapes on multiple scales. We used tree and shrub landcover classes from classified imagery as suitable landcover for urban deer. We validated the utility of FragPatch for generating relevant patch networks in a fragmented, urban landscape using biological thresholds derived from an extensive review of the white-tailed deer literature (*i.e.*, optimal distance to cover and flight response distance). We used deer observation data, collected using distance sampling techniques, to validate the patch networks resulting from FragPatch algorithms by comparing actual deer locations to random locations identified using a GIS.

Surgical sterilization for suburban deer management: myth or reality?

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In response to increasing negative effects on local biodiversity, agricultural and property damage, and deer–vehicle collisions, we implemented a white-tailed deer (*Odocoileus virginianus*) research and management program in 2007 on Cornell University campus, a suburban landscape in Tompkins County, New York, USA. We attempted to reduce deer numbers and associated impacts by surgically sterilizing female deer in the 445-ha suburban core campus. From 2007 to 2013, we utilized tubal ligation and ovariectomy surgical techniques to sterilize 93 deer, and we radiocollared 67 treated adult females and 26 control deer to monitor and compare fawning rates. While ovariectomy prevented birth in 100% of treated female deer, we experienced a 4% failure rate for those females treated with tubal ligation. We estimated annual deer abundance via a camera survey and a mark-resight model in Program NOREMARK, and observed no reduction in female deer estimates by winter 2013. In a post-hoc examination of sampled photographs, however, we noted a 38% and 79% decrease of total adult females and fawns visible in photographs, respectively, and an 873% increase in adult male visitation to camera traps within the study area. In the absence of lethal management, it appeared that surgical sterilization was ineffective for reducing a geographically open population of white-tailed deer. We provide an update to the ongoing deer research and management program on Cornell University lands.

7. Urban white-tailed deer

Exploring Scale Sensitivity of White-tailed Deer Through Spatial Point Pattern Analysis.

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Wildlife respond to important resources on the landscape at multiple spatial scales. Identifying spatial patterns is an important first step in understanding potential causative factors determining dispersion and scale sensitivity. A fundamental feature of dispersion is the degree to which neighboring observations (*i.e*., points) are aggregated or clumped. In this presentation, we examine properties of several indices of space-use by white-tailed deer (*Odocoileus virginianus*) across an urban-rural gradient and at several spatial scales. At the largest (48 km) spatial extent (*i.e.*, small scale) we mapped the locations of deer-vehicle collisions (DVCs) on a network of roads across rural Onondaga County, New York. We also recorded the locations of visual observations of deer during formal roadside surveys over a 6 km extent of a peri-urban landscape. Finally, we counted deer tracks on snow covered transects around selected urban green spaces over short (0.5 km) spatial extents (*i.e.*, large scale). We utilized a GIS and several variations of Global Moran's I to identify threshold distances (*i.e.*, spatial scales) at which processes promoting spatial clustering were most pronounced in each data set. We used identified thresholds to render maps revealing density variation by spatial scale. Kernel density estimates from the spatial point patterns at the mid- and lowest spatial extents were comparable to those estimated from conventional wildlife abundance surveys. Density variation reflected important behavioral constraints of deer relative to the presence of escape cover and its distribution across the landscape. Density variation in DVCs at the largest spatial extent was influenced by traffic volume, characteristics of the road network, and the distribution of escape cover. e demonstrate the utility of the Getis-Ord Gi* statistic for identifying hot-spots in spatial point patterns of deer space-use and discuss implications of point pattern analysis for managing wild animal populations.

8. Zoonotic diseases in urban and suburban areas / Toxicants

Human behaviors that modify the risk of contracting zoonotic disease from wildlife: a bio-economic perspective

Graham Hickling

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Wildlife managers approach the task of reducing risk to the public from zoonotic wildlife disease by manipulating factors affecting the abundance of infectious reservoir hosts and vectors. Typical examples include vaccination of rabid raccoon populations, and application of acaricide sprays in Lyme disease endemic areas. At the same time, health professionals seek opportunities to alter the behavior of the susceptible human population in ways that reduce risk of contact with infectious wildlife and vectors. Ideally, these two approaches proceed in tandem, but this is not always so. Altering human behavior is challenging, but has the potential to provide a faster and more-long lasting reduction in disease risk than can be expected from manipulation of the host/vector system. Individuals faced with disease risk choose between alternative responses to that risk. From an economic perspective, people are assumed to make decisions that maximize utility, an index of well-being. Individuals derive benefits (increased utility) from actions that also put themselves at increased risk of infection – for example, they may gain enjoyment from feeding a wild raccoon, or from tending their garden despite the presence of ticks. Unfortunately, they will also incur costs (reduced utility) if they subsequently become infected, with the expected magnitude of that cost depending on Likelihood x Severity of disease. Behavioral responses should be chosen, in theory, to adjust current benefits and future costs so as to maximize the expected net present value of utility. Unfortunately, we know that humans are often remarkably poor at assessing costs – tending to overestimate the risk of infrequent, catastrophic events, while underestimating the risk of common but less severe ones. In this presentation, I will discuss selected examples of efforts – some successful and some less successful --to guide the public regarding utility of outdoor activities vs. their risk of contracting zoonotic wildlife disease.

Host movement ecology and feeding behavior influence how resource provisioning affects infectious disease risk for wildlife

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Food provided by human activities such as agriculture, urbanization, and bird feeding can be more abundant than natural resources but have detrimental effects on wildlife by enhancing transmission of virulent pathogens. We conducted a phylogenetic comparative analysis of 285 host–parasite interactions across 55 wildlife species to identify life history traits that predict whether these anthropogenic resources increase or decrease infectious disease risk. Effect sizes between anthropogenic resources and infection with pathogens such as bacteria and viruses were greatest for wide-ranging species, herbivores, and migrants, suggesting taxa for which pathogen surveillance could be targeted or food subsidies could be limited to reduce spillover risk.

Diversity and Dilution: The Impacts of Medium-Sized Mammal Diversity on Borrelia burgdorferi Prevalence in Fragmented and Unfragmented Habitats in Connecticut, USA

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This study focuses on medium-sized mammal diversity and abundance in fragmented and unfragmented Connecticut woodlands. Medium-sized mammals can serve as reservoir hosts for *Borrelia burgdorferi*, but also create a dilution effect that can reduce local infection prevalence. In 2015 and 2016, camera traps were deployed in both residential properties and relatively large, unfragmented parcels of land. Imagery data will determine diversity and species richness of each location and between habitat types. Furthermore, percent infection of white-footed mice, the primary reservoir host for *Borrelia burgdorferi*, will be quantified. The mice will subsequently be used as a sentinel species to determine the difference in infection between unfragmented and fragmented areas. Understanding the dynamics of host diversity and their interaction with blacklegged ticks can play a crucial role in preparing management strategies for both the disease and its vector.

Challenges of managing wildlife rabies in urban environments

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Managing rabies in terrestrial wildlife populations protects human and animal health and significantly reduces the economic impact of the disease. Since 1995, the Wildlife Services' National Rabies Management Program has worked cooperatively with local, state, and federal partners to manage rabies across large landscapes in a variety of habitats to prevent the spread of and ultimately eliminate specific terrestrial rabies variants. Wildlife rabies control in the U.S. is primarily achieved through distribution of oral rabies vaccine (ORV) baits by fixed or rotary-winged aircraft targeting raccoons, coyotes, foxes, and skunks in rural areas. In 2016, 5% (537,202) of the 11 million vaccine-baits distributed in the U.S. were distributed by hand (vehicle) and 1% (96,490) by bait stations in urban-suburban environments where aerial operations in fragmented and highly developed habitats is often not feasible. However, adequately baiting these strategically important habitats targeting raccoon and striped skunk populations is essential for working towards the goal of raccoon rabies elimination in the eastern U.S. Rabies management on the urban-suburban landscape is complex as a result of increased population densities and knowledge gaps in understanding the ecology of target species, patchy distribution, anthropogenic food sources, and non-target species bait competition, resulting in lower seroconversion rates and persistence of rabies cases compared to more rural environments. Innovative approaches to improve vaccination effectiveness and efficiency in areas traditionally hand baited are required to achieve success. Recent innovations include increased use of helicopter distribution, evaluation of different bait station prototypes and densities, use of spatial technology including Point-of- Interest GPS and ArcGIS applications (Map Plus) to refine existing baiting tactics, and a comprehensive spatial ecology study of raccoons and striped skunks in Burlington, VT relative to ORV hand bait distribution strategies. These collaborative efforts will ultimately improve wildlife rabies management in urban-suburban environments.

An Integrated Tick Management Program to Reduce Risk of Lyme Disease in a Residential Endemic Area

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From 2013 – 2016, we conducted an integrated tick (*Ixodes scapularis*) management program in Redding, a forested, suburban town in southwestern Connecticut. Forty-two residences within four neighborhoods received various treatment combinations: 1) no treatment; 2) white-tailed deer (*Odocoileus virginianus*) reduction only; 3) a combination of a broadcast application of the naturally-occurring soil-borne fungus Met52 (Metarhizium anisopliae) and fipronil-based rodent bait boxes; and 4) a combination of deer reduction, Met52, and rodent bait boxes. Deer reduction efforts were extremely controversial; local hunters compromised this aspect of the project and reduction goals were not met. The most effective treatment combination for killing ticks was consistent application of Met52 and fipronil rodent bait boxes, which reduced mean questing nymphal densities 82% and mean immature ticks feeding on mice 89% compared to experimental control after three years.

Evaluation of IPM for Tick Control on School Grounds in the Northeastern United States

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The prevalence of tick-borne pathogens in increasing in the United States. Children are a subpopulation at high risk for Lyme disease in the Northeastern states because they spend significant amounts of time on school grounds that can have wooded perimeters, bushy vegetation, and wetlands can harbor ticks and their animal hosts. Area-wide acaricides, though effective for controlling ticks, are often prohibited or highly discouraged on school property, and have other potential environmental problems. This project assesses the impact of using two practical, safe, and commercially available host-targeted tick control methods simultaneously to reduce tick encounters at schools: 4-poster deer feeders and rodent bait boxes. While the effectiveness of these individual control methods to suppress the density of host-seeking tick nymphs has been well documented, there is very little known about the synergistic effect of using two methods, each targeting ticks at a different stage of their life cycle. Six schools in Prince George's County, Maryland were solicited for participation in this study; 3 treatment schools and 3 controls. Assessment of efficacy is being evaluated by year-round questing tick collection, and tick and tissue sampling of captured white-footed mice to determine pathogen status. Other behavior evaluations of wildlife interactions with host-targeted tick control products are being evaluated. The first year of this two-year project has shown high levels of *Borrelia burgdorferi* infection in captured-white footed mice, and differential use of rodent bait boxes by habitat. In addition, 4-Poster feeders demonstrate high levels of use by a variety of wildlife, but deer dominance behavior by specific does has been recorded, potentially reducing the effectiveness of the product. Evaluation of the combined use of these methods will provide meaningful data on the additive effects of dual tick control strategies, and could provide a proven model for tick control for schools.

8. Zoonotic diseases in urban and suburban areas / Toxicants

Wildlife associations with emergent influenza A viruses: implications for zoonotic disease and biosecurity

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Recently, several influenza A viruses (IAV) have emerged in both the New and Old Worlds.Some of these viruses have subsequently caused large economic, public health, and/or agricultural health burdens. We have conducted a series of laboratory and field studies that indicate that several non-waterfowl species (*e.g.*, non-traditional hosts) of wildlife can shed large quantities of some of these viruses or are exposed to these viruses in semi-urban settings. Thus, several wildlife species, especially those that are peridomestic, could play a role in the epidemiology of certain IAVs and should be accounted for in biosecurity plans.

Exposure of Wildlife to Anticoagulant Rodenticides at Santa Monica Mountains National Recreation Area: From Woodrats to Mountain Lions

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The National Park Service at Santa Monica Mountains National Recreation Area (SMMNRA) has been studying carnivores in the Los Angeles area for over two decades. Over this time we have collected data on many different aspects of the ecology on these carnivores living in urban environments, including home range size, landscape use, survival, causes of death, and human interactions. From these studies one of the most prevailing and concerning findings has been the ubiquitous and continuous exposure of wildlife to anticoagulant rodenticides. We have documented exposure to 6 different anticoagulant rodenticides, including both first and second generation compounds, as well as morbidity and mortality from this exposure, in species ranging from woodrats to mountain lions. We have seen rates of exposure as high as 92% in bobcats, 83% in coyotes, and 93% in mountain lions. We conducted some of the first examinations of exposure in target and non-target prey species, such as woodrats, ground squirrels, and rabbits. Although exposure rates in blood were low, liver residues in roadkilled animals were higher, and exposure rates in prey may not have to be high to affect higher trophic levels. The likely modes of exposure we have seen include primary, or direct exposure to bait stations placed in the environment, secondary, or consumption of previously exposed prey, and possibly even tertiary, as is likely the case in mountain lions, through the consumption of exposed carnivores such as coyotes. Both federal and state regulation of these compounds has changed during the course of the study, however exposure rates remain high and mortality has continued, even from regulated compounds.

Anticoagulant rat poisons impair immune function in a declining urban bobcat population

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Human activities threaten wildlife with numerous novel stressors such as exposure to toxicants. Anticoagulant rodenticides (ARs) are toxicants applied worldwide that, through bioaccumulation, threaten species that prey on poisoned rodents. We studied a population of urban bobcats (Lynx rufus) in southern California that declined rapidly from 2002-2005 due to notoedric mange. Before the mange outbreak, the disease was previously reported in isolated cases in wild felids globally. Subsequent investigations of bobcats that died of mange revealed that death from mange was strongly associated with AR exposure, suggesting that Ars may be an underlying contributorto susceptibility to severe mange. We integrated demographic, rodenticide exposure and pathogen information collected from an intensively studied bobcat population. We used a comprehensive suite of health assays comprising complete blood counts, blood chemistry assessments, and immunological profiling, to understand the health effects of AR exposure in a natural population. We found that sublethal AR exposure is associated with hallmark indicators of generalized systemic inflammation. This finding strongly supports the hypothesis that inflammation promotes immune dysfunction that may drive mortality. Such indirect effects of sublethal exposure exemplify the challenge of protecting wild populations from common toxicants in human-dominated environments.

9. Response to altered environments

Effects of urbanization on the reproductive success of grassland songbirds in San Diego County

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Many studies of urbanization investigate changes in the avian community composition from urban to rural habitats. These studies do not provide insight into urban effects on a landscape scale. Grassland songbirds have no ability to live directly within urban areas due to nest placement decisions, but urbanization present in the landscape surrounding grassland habitats may still influence grassland ecosystem health. Humans have had a tremendous effect on California's native grasslands, which are now just one percent of the original 9 million ha, and urbanization is the main threat to remaining fragments in San Diego County. The goals of my research were designed to address how grassland songbirds are affected by urbanization at varying intensities and scales. Five grassland study sites within San Diego County were sampled with varying degrees of urbanization in the surrounding landscape. Songbird presence, abundance, and reproductive success were determined for each site. The relative density of a main food source, grasshoppers, was also determined as well as the vegetation structure and composition of study sites. Finally, a technique for quantifying the amount of urbanization in the landscape surrounding study sites was developed. This technique was designed to be repeatable in any context and does not use arbitrary nomenclature for the varying types of land use. The results will show that the grassland habitats in San Diego County are idiosyncratic in nature likely due to the special patterns of development and land use history. We see that habitat structure and composition are important regardless of urban intensity. However, urbanization still has influence on grassland songbird community and nesting activity.

Nesting success of Urban and Rural Wood Thrush: Testing the Predation Paradox

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A growing body of work suggests that predator-prey interactions are decoupled in urban areas. In contrast with rural or intact habitats, a higher abundance of predators does not always indicate a higher rate of predation in urban and suburban areas. For passerine birds, this means that more squirrels, meso-mammals, and predatory birds does not lead to lower nest success in urban areas. To investigate this disjunction, termed the "predation paradox", we studied nest success and predator abundance in urban and rural forests in western Massachusetts. We focused on Wood Thrush (*Hylocichla mustelina*), a forest-breeding neotropical migrant which is declining throughout its range. During three breeding seasons, we searched for and monitored Wood Thrush nests. Potential predators were observed through point counts and motion-activated trail cameras. To compare the predator community between site types (urban and rural), actual predators were observed through continuous video recording at Wood Thrush nests. Nest success was relatively high in our study, providing a limited sample of actual predators. However, we observed raptors (both Accipiters and Buteos), sciurids, and a domestic cat depredating nests on video. Predator abundance, indicated by both point counts and trail cameras, was greater in urban sites. Nest success models indicated that site type (urban and rural) was not an important factor in determining nest success. Our results support the previous observations of the predation paradox. Further work is needed to investigate factors contributing to the predation paradox, as well as factors contributing to the decline of neotropical migrants, such as the Wood Thrush.

9. Response to altered environments

Are all cities created equal? The truth is not self-evident

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Urbanization is a major driver of biodiversity loss, often favoring only a few native species and excluding others. though mechanisms of this biotic filtering remain unclear. We ask if filtering occurs similarly in the cities of Fresno, California, Tucson, Arizona, and Phoenix, Arizona. Point count projects have provided species checklists and site-specific bird counts. Preliminary analyses have focused on species lists, using Jaccard's index for similarity, t-tests for continuous traits and Chi-square tests for distributions of nominal traits, such as dietary guild and migratory status. Jaccard's indices show that species pools are more similar than their urban bird communities. Indices are lower between urban communities (Fresno-Phoenix: 0.376, Fresno-Tucson: 0.293, Tucson-Phoenix: 0.581) than between species pools (F-P: 0.595, F-T: 0.532, T-P: 0.733) in every pairwise comparison. Fresno harbors the fewest native species, and exhibits the strongest trait-based filtering. The urban community differs in dietary traits from the pool in Fresno (Chi-square p=0.002, df =8), but not Phoenix (p=0.65, df=8), nor Tucson (p=0.98, df=8). A similar pattern emerges in migratory status. Data collection is underway for additional traits, such as reproductive effort, foraging strategy, body size, and brain size. Similarity between cities and their respective species pools follows a water use gradient; cities with less water use harbor bird communities more similar to their species pool. We propose that this is due to differences in urban habitat structure, i.e., more mesic vegetation in Fresno contrasting with arid native habitats. Results confirm findings that cities may not homogenize communities as suspected, and point to the potential for large, dense cities to retain native species through careful water use and design of urban habitats.

Effects of Artificial Light at Night on Heteromyid Rodent Foraging Behavior

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Artificial light at night, or anthropogenic light, is a rapidly expanding environmental pollutant both in terms the amount of light and the intensity of light. The associated loss of darkness has been shown to have negative effects on the behavior and physiology of animals and has unknown consequences for biodiversity and ecological and evolutionary processes. It has been hypothesized that nocturnal small mammals are particularly vulnerable to increased levels of artificial light because they have evolved to avoid predators under low light conditions. Under increased moonlight and artificial light small mammals have an increased predation risk by visual predators such as owls. We have conducted a series of experiments with several different species of hetromyid rodents to examine the impact of artificial lighting on foraging behavior. We used giving up density (GUD) as a tool to quantify the degree of risk perceived under various light conditions. We found significant changes in the foraging behavior of these animals as a function of the light type and distance from the light. These behavioral changes may have fitness consequences and ultimately influence persistence. Many species of heteromyid rodents are threatened with extinction because of habitat destruction and remaining fragmented populations are on the forefront of urban expansion. As human development increases, artificial light is expected to increase and these disturbances must be factored into management decisions to create sustainable refuges for these at risk species.

Drought effects on native stream breeding amphibians in Southern California

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At Santa Monica Mountains National Recreation Area (SAMO), the largest urban national park in the U.S., native stream breeding amphibians are exposed to many different stressors, including habitat fragmentation, roads, urban run-off, and drought. Together with our partners, the National Park Service has been monitoring native stream breeding amphibians in SAMO since 2000. In this talk, we will examine trends in amphibian occupancy and abundance as related to the amount of urbanization in watersheds, year-to-year fluctuations in temperature and precipitation levels, and co-occurrence with non-native invasive fishes and crayfish.

Effects of Fragmentation on the Spatial Ecology of the California Kingsnake (*Lampropeltis californiae)*

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We investigated the spatial ecology of the California Kingsnake (*Lampropeltis californiae*) in unfragmented and fragmented habitat with varying patch sizes and degrees of exposure to urban edges. We radiotracked 34 Kingsnakes for up to 3 yr across four site types: interior areas of unfragmented ecological reserves, the urbanized edge of these reserves, large habitat fragments, and small habitat fragments. There was no relationship between California Kingsnake movements and the degree of exposure to urban edges and fragmentation. Home range size and movement patterns of Kingsnakes on edges and fragments resembled those in unfragmented sites. Average home-range size on each site type was smaller than the smallest fragment in which snakes were tracked. The persistence of California Kingsnakes in fragmented landscapes may be related directly to their small spatial movement patterns, home-range overlap, and ability to use urban edge habitat.

9. Response to altered environments

Herpetofauna distribution patterns in the urban protected area of the Santa Monica Mountains National Recreation Area

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Urbanization poses a myriad of direct and indirect threats to native wildlife in and around the Anthropocene. Effective management of urban wildlife relies on robust estimates of urban wildlife populations combined with an empirical understanding of the individual effects of human development upon remnant wildlife communities. The Santa Monica Mountains National Recreation Area (SAMO) in Thousand Oaks, CA is an urban protected area under the National Park Service that has monitored the diverse herpetofaunal community for over five years using a network of pitfall and snake trap arrays. In our analysis, we utilized a selection of this capture data from 2012-2016 and the R package unmarkedto model the occupancy and abundance of SAMOs native reptile and amphibian species across an inclusive suite of urban attributes, including spatial data from public sources, and urban feature data collected at each array site. More specifically, we used this series of hierarchical models to compare relationships between specific species distributions and different urban attributes while also providing current estimates of local herpetofauna with respect to the surrounding development matrix of the Greater Los Angeles Metropolitan Area.

The movement behavior of the American White Ibis (*Eudocimus albus*) differs across a gradient of urbanization

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For many species, urbanization is associated with behavioral alterations such as reduced home range size, increased site fidelity, and abandonment of typical migration patterns. The risk of incurring negative health consequences increases when individuals reduce their movements and increase their use of urban habitats. As part of a larger effort investigating changes in the ecology and health of birds using anthropogenic resources, we analyzed the movement patterns of American white ibis (*Eudocimus albus*) along an urbanization gradient. A nomadic wading bird that once moved unpredictably between wetlands of the Everglades and other areas in the Southeastern U.S. following ephemerally available food resources, ibis have been increasingly found foraging in urban areas in south Florida and relying on artificial wetlands year-round. We hypothesized that as urban habitat use increased, space use would decrease concomitantly with increased site fidelity because urban resources are likely more reliable than wetland resources throughout the year. We captured 41 ibisesin urban parks and wetlands in south Florida and outfitted them with EcoTone backpack GPS transmitters recording 12 locations per day. We calculated occurrence distributions and measures of site fidelity for each ibis for breeding and non-breeding seasons. Non-breeding season ranges of urban birds averaged 2.7 km², while wildland bird ranges were as large as 600 km². Consistent with their larger home ranges, wildland birds had lower site fidelity, using more locations for roosting and foraging than urban birds. During the breeding season, range size and location changed for both urban and wildland birds, likely to accommodate nesting constraints. Unlike other species that are completely urbanized, ibis show variable reliance on urban and wildland habitats throughout the year. Movement behaviors of ibis using different habitats can provide meaningful information to understand the relationship between urbanization and wildlife health and predict likely effects of increasing urbanization.

From nomadic to hand-fed: shifts in diet and behavior in a recently urbanized wading bird

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Many species exhibit shifts in diet with urbanization to exploit the abundant and novel resources provided intentionally or unintentionally by humans. These shifts can also alter foraging behavior and habituation to humans, which have important consequences for species' ecology and human-wildlife interactions. We investigated these changes in a recently urbanized bird, the American white ibis (*Eudocimus albus*); nomadic wading birds of conservation concern that forage in shallow wetlands. Ibises have increasingly been observed in urban parks where they can feed on bread provided by people and insects in lawns. We hypothesized that ibises use urban habitats to forage on novel food sources thereby broadening their diets. We further hypothesized that intentionally provisioned ibises will become habituated to humans. Ibises were captured in seven urban parks (n = 126) and five wetlands (n = 74) in Palm Beach County, Florida. We analyzed ibis whole blood for 13C and 15N stable isotopes and quantified ibis diet using mixing models and isotopic niche width. We related ibis diet with habitat use by quantifying the landcover surrounding capture sites for all birds and GPS locations from a subset of birds (n = 41) outfitted with EcoTone GPS transmitters recording two-hour locations. Lastly, we recorded ibis habituation to humans on an ordinal scale at the capture site. Ibises that used more urban habitats, based either on capture site or GPS data, had diets significantly higher in anthropogenic food, lower in invertebrate prey, and had smaller dietary niches. Anthropogenic food was especially important for birds captured at sites where feeding was common and birds approached people. Our results suggest that urban ibises have less diverse diets than in wetlands and active provisioning of ibises in parks has a large influence on ibis diet and foraging behavior, all of which have importance consequences for urban avian conservation.

Poster Presentations

1. Sublethal Effects of Predators on Prey Behavior and Physiology within Urban Habitat Fragments

Carson Keller and Tim Karels

California State University, Northridge, CA

Primarily, the focus on predator-prey relationships has been on the direct effects of consumption. However, this top down effect only represents a portion of the total effect predators have on prey. Another effect is sublethal and a result of prey's anti-predator response to risk. Southern California's expanding anthropogenic influence makes it imperative to understand the full impact that these effects may have on predator-prey relationships, as well as the community and ecosystem dynamics it may irreparably alter. The sublethal effects of predators and human activity have the potential to change behavior and stress physiology in small mammals, resulting in the disruption of their many ecosystem roles such as seed dispersal, pollination, and primary consumers. Here I examine how the sublethal mechanisms, both acute and chronic, can alter dusky-footed woodrat (*Neotoma fuscipes*) foraging behavior, stress physiology, and fitness within urban habitat fragments in Southern California. By using giving-up densities and enzyme-linked immunosorbent assay (ELISA), I'm able to concurrently examine the behavioral and physiological impacts of increased perception of predation risk. Results suggest that under short-term increased risk, habituation may be responsible for limited changes in foraging behavior and acute spikes in stress hormones (glucocorticoids) potentially from previous high site specific risk. Chronic impacts of high perceived risk may be seen through reduced survival and reproduction, declining body condition, and increases in stress hormone levels. These effects may vary depending on the typical additional stressors individuals may be experiencing (*e.g.* proximity and frequency of anthropogenic influence and resource availability). Sublethal effects are important to quantify in small mammals; their vital role as primary consumers and food sources can make changes in population dynamics impact the entire community. Lacking this insight into predator-prey relationships within urban habitat fragments may act as a limiting factor in the success of future conservation and management strategies.

2. The (Dark) Night-heron Returns: Population Monitoring and Preferred Nest Height of an Endangered Black-crowned Night Heron Colony of in Chicago, IL.

María Jazmín Ríos, Mason Fidino, and Seth B. Magle

Urban Wildlife Institute, Lincoln Park Zoo, Chicago, IL

The Black-crowned night heron (*Nycticorax nycticorax*; BCNH) is a state-endangered bird species in Illinois, whose largest state population peaks during the summer in Lincoln Park, Chicago. Given the herons' colonial nesting behavior, it is important to assess population growth and nest features (*i.e.*, location, nest height, nest density, and tree height) to improve management of breeding populations. Although nest height has been studied in other species, it has not been systematically examined for the BCNH. We monitored the BCNH population in Lincoln Park, Chicago from 2010-2016 by performing daily population counts from February through August. Nest location and nest density was mapped in the summer of 2014, using Google Maps and ground thruthing. During the summer of 2015, we mapped and measured the height of 120 nests (2.3-14.1 m) and the height of the trees in which they were located (7.25-18.9 m). Over the 7 year study period, the heron population increased from 48 to 602 individuals. We observed an increasing quadratic relationship between nest height and tree height (R^2= 0.64).Results from abinomial regression further suggest that on average black-crowned night herons nest at 65% of a given tree's height, with an average tree height of 46 feet. Although data collection for this study is ongoing, results to date have improved our understanding of the roosting behavior for this species of conservation concern, and may allow us to better manage future BCNH populations in recently naturalized urban locations.

3. Effects of Anthropogenic Disturbance on the Carnivore Community: Using Human Indices from Camera-Trapping

Laura C. Young

City University of New York

This study investigates the effects that anthropogenic disturbance has on six focal species of the carnivore community in Hudson Highlands of upstate New York. One of the most basal types of anthropogenic disturbances is basic trail usage by hikers. The effects that human trail usage has on abundance, activity patterns, and species richness of carnivores in Black Rock Forest are investigated. Using camera-trap methods, the effects on individual species abundance are compared at varied levels of anthropogenic disturbance. Data are stratified by indices of human presence from camera-trapping. Unlike many studies, level of anthropogenic disturbance is irrespective of the camera location. Instead, anthropogenic disturbance is stratified with respect to how frequently humans use different segments offorest visitor trails. Results suggest significant anthropogenic effects for the six focal species investigated. Use of trails and narrow roads within the forest reserve are also found to impact the species richness within the order Carnivora. These results suggest continued daily camera-trap monitoring of trail usage is informative for land management decision-making which is beneficial for conservation of wildlife. Using camera-trapping as a technique for quantifying anthropogenic disturbance also lends itself to the movement ecology of the carnivore community, and how wildlife responds to variation in anthropogenic disturbances ranging from rural to urban landscapes.

4. Wild Mammals and their Pathogens in Los Angeles County,

California

Sarah Helman[1], Katie Prager[1], Jessica Lynch-Alfaro[1] and Jamie Lloyd-Smith[1]

[1]Ecology & Evolutionary Biology Department, University of California, Los Angeles

Little is known about the abundance, population dynamics and pathogen loads of mammals in and around the urban environment that dominates Los Angeles County. Urban wildlife can harbor and transmit many pathogens that have the potential to affect humans and domestic pets, including bacteria in the genus *Leptospira* (detected in the domestic dogs of Los Angeles County) and various intestinal pathogens (*e.g. Giardia, Salmonella, Cryptosporidium*). Pathogens such as canine distemper virus (CDV) can also spill over from humans or their pets into urban wildlife populations. This virus has caused major declines in wild carnivore populations, and has been suspected in past disease outbreaks in Los Angeles wildlife. To address existing knowledge gaps in urban mammal population health, we will conduct a 2-year survey of six abundant mammal species (coyotes, raccoons, skunks, opossums, rats and squirrels) that have the potential to carry pathogens of zoonotic and conservation concern. Pathogen samples will be collected from urban wildlife at rehabilitation centers and animal control agencies, and will be paired with host genetics to increase our knowledge of urban mammal population dynamics and connectivity. Over the course of this 2-year survey, patterns of occurrence will be mapped in relation to indices of urbanization to understand the distribution of pathogens across this urban landscape, aiming to inform local wildlife, veterinary and public health agencies about pathogen occurrence and transmission potential in these urban mammal populations. Here we will report preliminary results from these disease surveillance efforts in and around the Los Angeles area.

5. The Urban Biodiversity Inventory Framework

Leslie Bliss-Ketchum

Samara Group LLC, Portland, OR

The Urban Biodiversity Inventory Framework (UBIF) and associated online tool (at http://ubif.us) is a flexible yet robust framework designed to provide cities with appropriate guidance in order to successfully record, analyze and assess biodiversity information in urban areas. Cities are increasingly being recognized as important locations for local biodiversity, endangered species and/or for providing key stopover sites for migratory species. As human populations grow and available habitat areas shrink, the need to track and maintain urban biodiversity becomes increasingly important. By providing a way to accurately and consistently assess biodiversity resources and track changes over time the UBIF can assist cities in making appropriate management decisions to protect this critical asset. The UBIF assists cities by providing a record of biodiversity information to support proactive efforts to maintain and enhance biodiversity as well as the ability to identify the need for response when species are declining. By applying the UBIF methodology, cities can monitor the response to actions designed to enhance biodiversity, such as restoration activities. The UBIF structure also allows cities to record changes in biodiversity for a specific species, taxa group, or for multiple taxa in a specific habitat of interest. This flexibility provides information at different levels of organization and can also be used to generate a “report card” or summary score, aiding in communicating of biological information to diverse audiences. Phase 1 of the UBIF project was initiated by five partner cities (St. Louis MO, San Francisco CA, Portland OR, Pittsburgh PA and Philadelphia PA), active in the Urban Sustainability Directors Network (USDN) with funding from the USDN and Summit Foundation. These cities selected Samara Group LLC to develop the frameworkin recognition of the need to accurately assess biodiversity in urban areas.

7. Measuring Hair Cortisol in Urban Eastern Grey Squirrels, Eastern Cottontails, and Raccoons: Does the Level of Urbanization Matter

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As urbanization increases globally, select wildlife respond by adapting to human-dominated urban landscapes. Passive monitoring techniques help determine urban wildlife community composition, but need to compile health and stress information. Chronic stress can damage individual health through reproductive and immune system suppression. By extracting cortisol from hair, one can understand individual stress levels up to several months before collection. Therefore, our objectives were to: 1.) develop methods to measure cortisol in hair; and 2.) determine if the degree of urbanization influenced cortisol levels of three urban mammal species. We hypothesized that higher hair cortisol concentrations in target species located in human-dominated landscapes due to environmental pressures such as land-use change, resource loss, and higher conspecific populations. To develop hair cortisol analysis methods, we collected the hair from up to 10 different locations (belly, base neck, base tail, chin, dorsal, right/left front, right/left hind, tail) of deceased raccoons (*Procyon lotor*, n=8), eastern grey squirrels (*Sciurus carolinensis*, n=14), and eastern cottontails (*Sylvilagus floridanus*, n=4). Squirrels and rabbits were sampled from a location with a high population density (>3,000 persons/mi2) compared to the raccoon samples collected in areas with populations of ≤3,000 persons/mi2. Hair cortisol levels did not vary among body sites on the raccoon (84.46 ±16.06 ng/g) and cottontails (13.24 ±1.61 ng/g), but was lower (p value) in tail hair (mean SE) then the rest of the body (mean SE) in squirrels. Results demonstrated that mean (±SE) cortisol varied among individual cottontails ($p<0.001$) and squirrels ($p<0.001$) but not raccoons ($p=0.094$). In conclusion, hair is an effective method to study long-term stress in urban mammalian species; however, hair should be sampled from the same location to reduce variability due to hair morphology. Likewise, high human density landscapes may result in unpredictable habitats for wildlife as evident by varying levels of cortisol among individuals.

8. Puma Tracking Webmap

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More than a decade ago, The Nature Conservancy and partners recruited new members to our science team: pumas. We needed their help to figure out how they navigated the obstacle course of roads, backyards and fragmented habitats east of San Diego and Los Angeles. Outfitted with GPS collars, the pumas gave us detailed accounts of their every movement. We used that information to prioritize which corridors to protect and which stretches of highway to make safer for animals to cross, helping us keep this rapidly urbanizing landscape stitched together as an ecological whole. Now, with the assistance of ESRI EEAP program, we have daylighted the data so that Conservancy staff and collaborators can visualize the movements, interactions, and temporal behaviors of these incredible creatures.
Current Functionality:

- Quickly visualize the entire movement history of one or more pumas
- Visualize the movements of multiple pumas simultaneously
- Choose data based on specific time window
- Visualize puma movement through the landscape:
  - When and where do they cross roads?
  - When and where do they rest?
  - When and where do they eat?
  - What habitat do they prefer?
- Click on puma data point to view timestamp
- Adjust time interval (5 min, 1 hour, 2 hour, 6 hour)
- Adjust speed at which time passes
- Scroll through time
- Step through time
- Change the color of the puma symbol
- Visualize the change in sunlight to quickly see if pumas are moving during daylight, dusk, dawn, or night.
- Add associated layers: Land Owner, Land Cover, Model Outputs
- Choose from multiple base maps – imagery, topography, street map, simple gray

9. MESOPREDATOR OCCURRENCE IN AN URBAN LANDSCAPE ON THE SOUTHERN HIGH PLAINS OF TEXAS

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Urban landscapes are becoming more recognized as viable environments for thriving mesomammal populations, where greater attention and interest in wildlife-human coexistence has spurred dramatic advances in urban wildlife ecology and management science. In urban settings, wildlife coexistence with humans may create elevated conflicts, persecution, and concerns regarding potential disease transmission to humans and pets. However, relevant anthropogenic and environmental factors influencing wildlife presence in urban systems remain poorly known, which are key for developing mitigation plans for potential conflicts. To date, few data have been collected on presence and composition of mesomammals in urban settings of the Southern Great Plains. This research is focused upon relating habitat and anthropogenic features with presence, occupancy, and distribution of coyote (*Canis latrans*), domestic dog (*C. lupus familiaris*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), domestic/feral cat (*Felis silvestris catus*), raccoon (*Procyon lotor*), and Virginia opossum (*Didelphis virginiana*) within the city limits of Lubbock, Texas. To date, > 600,000 images have been collected from camera-trap surveys conducted during spring, summer, and fall 2016 within 15 randomly selected 1 km^2 cells overlaid on the boundaries of Lubbock city limits. Cats have been most common, with detections in all but one sampled cell, opossums and gray foxes were detected in 12 cells, while coyotes, wild dogs, red foxes, and raccoons, were detected in 3, 2, 2, and 4 cells respectively. Potentially relevant covariates influencing gray fox and opossum presence include mean housing prices, greater comparative canopy cover, but negatively related to feral cat relative density. Coyotes have only been detected in areas near more non-urban habitats within this urban matrix. However, further camera surveys will continue using an adaptive sampling approach to further expand the spatial extent and more clearly identify relevant covariates associated with these mammals in Lubbock, Texas.

10. MONITORING URBAN INTERFACE UTILIZATION BY FERAL CATS FOR ENDANGERED SPECIES CONSERVATION

Austin Parker

Cabrillo National Monument, San Diego, CA

Cabrillo National Monument is a National Park Service entity surrounded by the urban areas of coastal San Diego and provides 163 acres of intact coastal habitat for native wildlife. A species that utilizes this reserve area is the California Gnatcatcher, listed as Threatened under the Federal Endangered Species Act. In 2013, the California Gnatcatcher was observed in the park for the first time since 1915. In 2015 they were observed to have fledged two successful nests, the first documented on the peninsula in 100 years. In the summer of 2014, Cabrillo National Monument started monitoring feral cats via passive camera traps. Feral Cats have been known to prey on song bird, small mammal and herpetofauna species indiscriminately, without regard for native species population levels or their own food availability. It was determined that the cats are entering the park from adjacent properties owned by the US Navy, County of San Diego, and US Department of Veteran's Affairs. These and other organizations have formed a partnership with Cabrillo National Monument for urban-ecological management on the Point Loma peninsula called the Point Loma Ecological Conservation Area (PLECA). Itis evident that there is multiple cats, at least 4 since 2014, that have entered the park at all hours of the day. They have not been observed predating on native species dueto their nocturnal habits and it is not known where these cats originated or how they found their way to the Point Loma peninsula. Cabrillo National Monument Natural Resource Management and Science division has ongoing monitoring projects for both the California Gnatcatcher and feral cat populations for potential impacts to the endangered species' population. Continued monitoring of the feral cats will be necessary for decision making on management actions tobe taken to conserve the our population of endangered songbird.

11. CABRILLO FIELD NOTES: SNAKE ENCOUNTERS OF THE THIRD KIND

Reyna Zavala[1], Alex Warneke (MS)[1], Jonathan Q. Richmond (PhD)[2], and Stephanie Root[1]

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We will present a short animated video, played on a loop, featuring Jonathan Richmond of the USGS explaining the potential effects of introducing captive, non-native herpetofauna into a small, island-like urban preserve. We will specifically address an instance in May of 2016 when a hybridized kingsnake was found at Cabrillo National Monument in San Diego when it was apparently copulating with a native, California kingsnake. The implications of releasing pets into the wild are magnified when it occurs in such a small, sensitive setting.

12. RECENT FINDINGS ON BATS OF THE POINT LOMA PENINSULA

Drew Stokes[1], and Stephanie Root[2]

[1]Department of Birds and Mammals, San Diego Natural History Museum; [2]Cabrillo National Monument, National Park Service

Year-round use of the Point Loma peninsula by bats has not been well understood, with past surveys generally covering the spring and summer months when bat activity is usually higher than other times of the year. Additionally, Cabrillo National Monument and San Diego Natural History Museum biologists are investigating potential pollinators of the Shaw's agave, a threatened native plant species of high management value. One of these pollinators is suspected to be the nectar-feeding *Choeronycteris mexicana*, a species that is thought to occur, but hasn't been documented in the peninsula. To get a better understanding of how bats use the peninsula, a cadre of acoustic detectors was set up to run for 10 nights for each season, and opportunistically at Shaw's agave locations when in bloom. Results from monitoring efforts between 2014 and 2016 will be presented, with emphasis on the Point Loma peninsula and its importance as a stopover and foraging area for migratory and resident bat species, particularly during the fall season.

13. LESSONS FROM BUILDING A 21ST CENTURY ROCKY INTERTIDAL

Alexandria Warneke, Nicole Ornelas, Andrew Rosales, and Dr. Keith Lombardo

Cabrillo National Monument, National Park Service

Our goal as interpreters is to facilitate meaningful connections for park visitors to the resources we protect in our urban environment. We effectively accomplish this goal by linking intangible ideas to tangible objects. Unfortunately, select examples are unavailable for tactile learning purposes due to their high value or fragile nature. Through the 3D Cabrillo program, we initiated a platform to construct 3D replicas of our park's natural and cultural resources. These objects enhance our public interpretive programs at the park and are freely available online for community use. Cabrillo is a leader in science communication in the National Park Service and our 3D program is one innovative example of how we are bringing our nation's parks and wildlife into the digital age with opportunities for a quickly evolving youth in our local and national communities. With these techniques, we look to raise awareness of park resources and foster excitement for the next century of stewardship.

14. EVALUATION OF MOVEMENTS AND HABITAT USE OF SUBURBAN STRIPED SKUNKS (*MEPHITIS MEPHITIS*) IN THE NORTHERN GREAT PLAINS

Anna Schneider[1], Amy Gilbert[2], Brett Goodwin[1], Michael Niedzielski[3], and Jason Boulanger[1]

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Few studies have investigated the ecology of urban striped skunks (*Mephitis mephitis*), particularly in the Northern Great Plains, despite their role as a primary rabies vector species paired with an ability to thrive in these landscapes. Our aim is to obtain baseline ecological information to better inform rabies management decisions. During summer 2016, we captured 86 skunks (59 kits, 15 adults, and 10 adult recaptures) over 2,026 trap nights. We captured most of the skunks within the urban/rural interface; few were captured within the urban landscape interior of our study area. Of 15 adults (3 male, 12 female) fitted with VHF radio collars, 5 disappeared from the study area and 2 died from vehicle collisions. We monitored the remaining 8 females from fall 2016 through winter 2017; to date, mean home range for adult female skunks appears to be less than 3 km^2. We collected data on nightly movements, home ranges, habitat use, and denning behavior. Trail cameras at the denning sites recorded communal denning at multiple sites and, in one location, we observed at least 5 skunks denning with a domestic kitten (*Felis catus*). We will continue to trap and monitor movements beginning in spring 2017. Here we present partial results from this ongoing study.

15. URBANIZATION AND ITS EFFECTS ON RESOURCE USE OF COYOTES (*CANIS LATRANS*) IN SOUTHERN CALIFORNIA

Rachel N. Larson[1], Justin L. Brown[2], Seth P.D. Riley[2], and Tim J. Karels[1]

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As humans increasingly develop and inhabit urban areas, the number of species coming into contact with humans is increasing. SouthernCaliforniais one of the largest metropolitan areas in the United States, yet populations of mammalian carnivores, such as coyotes (*Canis latrans*), can still persist there. The increased availability of anthropogenic resourcesis an often cited, but still poorly understood mechanism for possibly attracting and sustaining wildlife populations in urban environments. For example, coyotes may shift their diet in urban areas to consume more anthropogenic resources such as trash and domestic animals. However, substantial use of anthropogenic resources does not appear to be a prerequisite for successful colonization of urban environments. Previous studies have found coyotes capable of maintaining territories with high proportions of modified land butlow occurrences of anthropogenic items in their diet. Our goal is to describe the diet of coyotes living in the urban areas of Los Angeles and draw comparisons to the diet of coyotes from surrounding suburban and rural areas. Some of our urban habitat patches are completely cut off from natural areas by miles of development and large roads. Nevertheless, coyotes should be successful in this urban environment because of their ability to utilize available anthropogenic resources. We plan to use scat analysis to obtain a record of diet for coyotes living in urban patches, suburban open spaces, and rural protected parks. Preliminary results indicate the common occurrence of anthropogenic items in urban coyote scats (45% of scats).However, natural prey items are equally as common (58% of scats). Studying the diet of urban coyotes will help us understand how these carnivores colonize and persist in human-dominated landscapes and how they influence urban ecosystems. Increasing our understanding of coyotes will inform wildlife biologists on the best steps to take to preserve and protect wildlife resources.

16. URBAN CONSIDERATIONS FOR ECOLOGICALLY BASED RODENT MANAGEMENT

Alexis Smith

University of Illinois, Chicago

Rodents such as Norway rats (*Rattus norvegicus*) live in high densities in cities and threaten human health and property. This is a conservation concern, because the rodenticide used in response can harm and kill non-target wildlife. Rodenticide may also paradoxically shift the predator-prey equilibrium so that there are more rodents and fewer rodent predators. As an alternative to rodenticide, ecologically based rodent management (EBRM) applies ecological research to rodent control practice. The primary goals of EBRM are to minimize harm to non-target species and the environment, and to develop approaches that are long-lasting and economically-feasible for those who need to employ them. Researchers have made progress in ecological management of rodents in agriculture, but there has been little focus on EBRM in urban systems. Drawing from theoretical ecology, natural history, and new analyses of previously published data, this poster discusses both the motivations for and logistics of developing urban EBRM plans.

17. ONGOING MONITORING OF SMALL MAMMALS IN THE URBAN INTERFACE OF KAMLOOPS, BRITISH COLUMBIA, CANADA: A REVIEW OF 20 YEARS OF DATA COLLECTION

Sheri Watson and Dr. Karl Larsen

Thompson Rivers University, Kamloops, British Columbia, Canada

Wildlife that utilize urban greenspaces includes small mammal populations (Mahan and Connell 2005). Small mammals are a fundamental component of the ecosystem as they are prey for avian predators (*e.g.* Hindmarch and Elliot 2015) and mammalian predators such as coyotes (Larson *et al*. 2015) that also use urban areas. Here we report on a continuing study of small mammal communities in the urban grasslands of Kamloops, British Columbia (BC), Canada. Kamloops, BC, has a semi-arid steppe climate (Demarchi 1996) with a population of over 85,000 people (City of Kamloops 2011). Within Kamloops city limits numerous urban greenspace areas can be found including 26 open space parks, the largest being Kenna Cartwright Park at 690 hectares (1705 acres) (City of Kamloops). We have conducted an ongoing annual small mammal mark recapture live-trapping census each fall at three sites in Kamloops since 1997. Each year at each site 60 Longworth traps are pre-baited for three nights, traps are then set for three consecutive nights and checked each morning. Trapping has been conducted by senior students in the Natural Resource Sciences Program at Thompson Rivers University. Population estimates arecalculated using the program CAPTURE (Otis *et al*. 1978). The two dominant species trapped have been deermice (*Peromyscus maniculatus*) and voles (*Microtus montanus*). Population estimates of deermice and voles have shown variability over time and in some years no voles were captured. Deermice have been caught every year and were higher in number compared to voles throughout our 20 year study. Our data show that greenspaces of Kamloops continue to support small mammal populations over time. Long term monitoring of small mammal populations provides information about prey presence and abundance that assists local wildlife managers in the conservation and management of predator species that also use urban greenspaces.

18. MICROCLIMATE ANALYSIS OF NEOTOMA BRYANTI HOUSES IN THE SANTA ANA WASH

Brian Keyser

University of Redlands, Redlands, CA

Neotoma bryanti, a subspecies of the *Neotoma lepida* group, inhabits much of coastal California and Baja California. Other species of the group inhabit the great basin and low deserts both west and north of the Colorado River (Patton, 2014). The group must cope with extreme summertime temperatures that sometimes exceed their ULT (upper lethal temperature) of 41.4 °C or 106.5 °F (Brown, 1969). In order to understand how N. bryanti copes with lethal temperatures a survey of 88 packrat houses was conducted in summer of 2016 in the juniper-dense Santa Ana River wash outside of Redlands, California. Redlands is within the Riverside-San Bernardino-Ontario metropolitan area which has an estimated population of 4 million. Data was collected on house location, size, and direction on tree. Climate data was collected from both the interior and exterior of the shelter. It was found that 54% of the houses occurred on the south side of the tree. Furthermore, the interior of the house had a significantly cooler temperature with less temperature fluctuation than the exterior of the same house. The results are consistent with the hypothesis that *N. bryanti* is able to escape lethal temperature by residing in the deeper portion of the house during the hottest parts of the day. The incentive for building shelters overwhelmingly on the south side of the tree is still under investigation.

19. THE ECOLOGICAL IMPACTS OF CLIMATE CHANGE ON A BIODIVERSITY HOTSPOT

Amber Pairis[1], Megan Jennings[2], Julie Kalansky*, Dan Cayan*, Rachel Clemesha*, Alexander Gershunov*, Kristin Guirguis*, Dawn Lawson[3], David Pierce*, John Randall[4], Eric Stein[5], Alexandra Syphard[6], and Sula Vanderplank[7]

[1]Climate Science Alliance-South Coast & CA Dept. of Fish and Wildlife; [2]San Diego State University; [3]U.S. Navy (SPAWAR SSC Pacific); [4]The Nature Conservancy; [5]Southern California Coastal Water Research Project; [6] Conservation Biology Institute; [7]San Diego State University

The Mediterranean ecosystems of southern California are some of the most ecologically diverse systems outside of the tropics. The richness and diversity of plants and animals, as well as high rates of endemism make the area a biodiversity hotspot. San Diego County is a particularly unique part of southern California, considering the region's complex topography and highly variable precipitation and other climatic factors, which play an important role in determining the resident biological palette. While home to a major metropolitan area, San Diego County still hosts expanses of native and preserved habitats where management and conservation action could be greatly enhanced through science-based assessments and planning for climate change and increased climate variability. In partnership with the Climate Science Alliance – South Coast, a unique collaboration of local ecologists and climatologists is conducting a review of the impacts of climate change on San Diego County's terrestrial and stream ecosystems. In this assessment, we will review the state of the science on the likely climatic changes expected and describe the region's unique diversity of ecosystems, habitats, plants, and animals, as well as their susceptibility to impacts from climate variability and relevant synergistic impacts of anthropogenic factors that may be exacerbated by a changing climate (*e.g.*, urban growth, land use shifts, and fire regimes). Here, we present the initial work from this effort, describing the motivation behind our focus on the San Diego region as well as the preliminary assessment of our natural resources at risk from climate change and co-occurring stressors.

20. THE VALUE OF WILDLIFE IN AN URBAN WORLD

Julianne Taylor

Wildlife Management, Oregon State University, Corvallis, OR

As human encroachment on wild areas rapidly increases, the availability of suitable habitat for wildlife rapidly decreases. Green urban spaces increase connectivity for dispersing wildlife and may offer travel corridors, habitat, or food sources. It is evident in an ever-populous world that some wildlife species have adapted to an urban setting; it is likely that as much urban green space as possible will need to be preserved to retain the direct and indirect benefits of urban wildlife. Educational opportunities build biophilia, which aids in the increase of awareness and respect for wildlife and the ecosystem, leading to increased public support. Economic and social benefits can be gained from urban wildlife, as well. Studies have found that real estate properties tend to increase in value in proximity to enhanced views and water features that green spaces offer. Many urban green spaces offer trails for walking or viewing wildlife; communication and socialization have been shown to increase through utilizing these trails. Arguably, the most important values that wildlife brings to an urban setting are ecosystem services. Apex predators in an urban setting maintain balance of trophic cascades, decreasing the likelihood of mesopredator release. Wildlife in an urban setting leads to increased biodiversity, ecological integrity, seed dispersal, sediment control, and increased water quality. There is intrinsic value of wildlife in urban settings for those species that have already adapted to living in a fragmented landscape. Because of the conflicts that arise when wildlife enters urban areas, it may be difficult for scientists and planners to gain enough public support to preserve large areas of urban green space. However, it is a challenge that must be overcome to ensure the conservation of essential wildlife habitat and public safety.

21. CALIFORNIA LEAST TERN: THE CHALLENGES OF CONSERVING A MANAGEMENT-DEPENDENT ENDANGERED SPECIES IN URBAN CALIFORNIA

Nancy Frost

California Least Tern Breeding Survey Program, San Diego, CA

Federally- and state-listed endangered California least terns (*Sternula antillarum browni*) nest along the west coast of North America, from Baja California, Mexico, north to the San Francisco Bay area,and winter along the west coast of Central and South America. They migrate to nesting areas by mid- to late- April and are generally present through September. During this time, they establish nesting colonies on sandy soils with little vegetation along the ocean, lagoons, and bays, the majority of which are adjacent to concentrated urban development and human recreational land use. To reduce the impacts of human development, intensive management and monitoring is conducted annually at the nesting colonies. Colony management includes the removal of non-native vegetation to maintain open nesting areas with some dense vegetation that can be used by chicks to hide from predators. The predators known to be responsible for the greatest number of depredated California least terns are urban-adapted species including coyotes, corvids, and raptors. Of the 60 subcolonies that were monitored in 2016: 84% were managed to reduce vegetative cover, if necessary; 71% had predator management; and 73% were protected by fencing or an adjacent water body to prevent trespass by humans and off-leash dogs. Colony management and monitoring, as well as public education, will need to continue in perpetuity to ensure the conservation of this management-dependent species.

22. PASSIVE WILDLIFE MONITORING USING CAMERA TRAPS

Alexandra Rebosura, Claudia Garcia, Shuzel Lide, Mysha Turna, Joseph Svoboda, and Elizabeth Carlen

National Science Foundation, Wildlife Conservation Society, Fordham University, Project TRUE (Teens Researching Urban Ecology), New York City Parks

Increased urbanization – the construction of anthropogenic structures that fragment natural spaces – has greatly impacted the number of species per unit area, or species richness. Passive wildlife monitoring using camera traps is a common method for studying species richness and encounter rate – number of groups of animals observed per unit survey effort – because they prevent influence from lures and allows for continuous monitoring. In the northernmost borough of New York City, the Bronx Zoo is a 265 acre park with mixed urban and natural areas. We studied how urbanization correlated with species richness in different sites around the natural areas around the Bronx Zoo exhibits. We tested three hypotheses: first, greater distance from a walkway positively correlates with increased species richness; second, greater distances from the major roadways positively correlates with species richness; third, there will be greater species richness by walkways that without barriers, such as fences or guardrails. Our data supported our hypotheses that the there would greater species richness farther away from the roads and walkways. Of 560 total encounters, we found more bird encounters than mammal encounters and speculated that the cameras' position above the leaf litter may have affected the visibility of present species, for encounter rate calculations. However, when comparing the walkways, we found that the the species richness at the camera sites near to walkways were not statistically different. We concluded that this data suggests that urbanization, in the form of paved throughways, negatively impacts the number of wildlife species present. This data can be further applied to advocating for the maintenance of natural spaces, in protection of our wildlife.

23. IMPLICATIONS OF ANTHROPOGENIC INFLUENCE AND HYBRIDIZATION ON WILD CANID NICHE CHARACTERISTICS

Justin Johnson

Trent University, Ontario, Canada

Anthropogenic habitat modification has dramatically reduced reproductive barriers between organisms and influenced species distributions at a continental scale. Increased contact between former allopatric species increases the potential for hybridization, which can cause cascading ecological effects if the hybrids are unable to fill the ecological niche of the parental species. My research investigates the effects of hybridization on niche characteristics between wild canid species across eastern North America, with a focus on how anthropogenic influences such as roads, human population density, and land conversion affect distributions at a broad scale. The distributional expansion of coyotes (*Canis latrans*) throughout post-colonial North America is often associated with anthropogenic land conversion and infrastructure development, and coyotes readily hybridize with eastern wolves (*C. lycaon*), a threatened species in Canada. Therefore, increased contact between coyotes and eastern wolves due to landscape conversion may be intensifying hybridization. Maintaining genetic integrity is critical for small populations of at-risk species such as the eastern wolf, so identifying critical habitat and understanding how human influence impacts these populations is helpful for conservation strategists. Eastern wolves also readily hybridize with grey wolves (*C. lupus*), however very little is known about the ecology of these hybrids. Consequently, quantifying niche space for these canid species (*C. lupus*, *C. lycaon*, *C. latrans*) and their hybrids will help us better understand how these animals are affected by human encroachment and hybridization. I am utilizing genetic techniques to delineate my samples into species groups and subsequently creating environmental niche envelopes for each group to compare niche overlap and breadth between each group. These results will quantify associations between habitat features and each species group and will provide insight on the impacts of anthropogenic influence on exacerbating hybridization.

24. THE CHALLENGES OF MANAGING COASTAL LAGOON IN URBAN ENVIRONMENTS FROM A STATE WILDLIFE AGENCY PERSPECTIVE

Hans Si and Tim Dillingham

California Department of Fish and Wildlife, San Diego, CA

California Department of Fish and Wildlife's (CDFW) South Coast Region (Region 5) encompass 5 coastal Counties: Ventura, Santa Barbara, Los Angeles, Orange, and San Diego. Combined populations of these counties exceed 17 million people with large population concentrations along the coast. Also along the coast line are unique coastal wetland habitats (lagoons) that provide refugia, nesting areas, and stop overs for many species of migratory and residential bird species as well as an array of other taxa such as invertebrates and herpetofauna. Many of these species are both State and federally listed, such as California least tern, snowy plovers, and light-footed Ridgway's rails. However, these unique coastal wetland systems are surrounded by urban and suburban areas that bring well-known associated issues; encroachment of invasive species, chemical runoff, various human land use issues, and management of listed species. CDFW's South Coast Region manages 7 coastal wetlands that combined are over 2500 acres. These coastal wetlands have the above listed issues along with additional management challenges such as maintaining road infrastructure, coordinating the maintenance of pipelines, dredging lagoon mouths for water flow for water quality, coordinating education/outreach programs, and facilitating recreational activities all in a landscape of highly dense human populations.

25. THE RELATIONSHIP BETWEEN MID-LEVEL DISTURBANCE AND OCCUPANCY FOR THE ENDANGERED STEPHENS KANGAROO RAT (*DIPODOMYS STEPHENSI*).

Denise R. Clark, Cheryl S. Brehme, and Robert N. Fisher

U.S. Geological Survey, Western Ecological Research Center, San Diego, CA

The endangered Stephens' Kangaroo Rat (*Dipodomys stephensi*: SKR) is patchily distributed throughout San Diego and Riverside Counties amongst a patchwork of urban development. As part of a monitoring program for SKR on Marine Corps Base Camp Pendleton (MCBCP), U.S. Geological Survey (USGS) analyzed habitat characteristics and disturbance measures and their effects on species occupancy from 2005 to 2015. Habitat characteristics included: landscape characteristics (slope, soil compaction), vegetation cover characteristics (shrub cover, forb cover, native grass cover, non-native grass cover, and open ground), and disturbance measures (foot traffic, off-road vehicle use, roads, fire management, and recreation).Habitat disturbance (UOR) was scored in the field from 0 to 100 using measures that incorporated both the spatial extent of the habitat disturbance (from 0 to >75% of habitat affected) and its relative impact to the habitat. Overall, disturbance was a strong predictor of SKR occupancy. The probability SKR occupied habitat was greatest at intermediate levels of disturbance (UOR 14-47). Low levels of disturbance (<14) and High levels of disturbance (>47) were less suitable for SKR. In addition, SKR occupancy is positively associated with the proportion of forbs and open ground and negatively associated with the cover of shrubs and non-native grasses. Disturbance on MCBCP likely serves to decrease cover of shrubs and non-native grasses and thus maintain the open ground and herb/forb dominated habitat that is suitable for SKR. Although they are known to be negatively affected from artificial lighting and road mortality in urban areas, our results indicate that some types and levels of human disturbance can help to maintain suitable habitat for SKR.

26. A PROPOSED ANALYSIS OF DEER USE OF JUMPOUTS RAMPS AND FELID USE OF CULVERTS ALONG HIGHWAYS WITH WILDLIFE EXCLUSION FENCING.

Alex Jensen[1], John Perrine[1], Nancy Siepel[2] and Morgan Robertson[2]

[1]California Polytechnic University, San Luis Obispo, CA; [2]CalTrans, San Luis Obispo, CA

Highways can fragment habitat and be a significant mortality source for large and medium sized mammals. Wildlife exclusion fencing can exclude animals from the highway corridor, but can also prevent animals from escaping from the corridor if they enter at ungated access roads or fence ends. Earthen escape ramps, or "jumpouts" have been proposed as a possible solution, but they remain relatively untested. We documented wildlife response at 4 jumpout ramps in a 2.5-mile wildlife exclusion fence project on Highway 101 near San Luis Obispo, California, from 2012-2016. We also documented wildlife use of culverts. Four years of data provides unique insight into seasonal patterns as well as long term adaptation to these structures. Preliminary analysis of the jumpouts indicated that Mule Deer used the jumpouts, but these events were comparatively rare, and the data were confounded by pseudo replication (repeated visits by the same individual deer). Additionally, there appeared to be variation between antlered and non-antlered deer, which warrants deeper investigation. Ideally the exclusion fence helps "funnel" wildlife to safe passage across the highway, *i.e.* culverts. Felids are our focal species for the culverts because our study site crosses a modeled mountain lion corridor in the Los Padres forest, and bobcats are an ecologically important mesocarnivore. We propose a multivariate analysis of the factors influencing felid use of culverts including culvert dimensionality, local habitat and topography, and proximity to cover. The goal is to reduce wildlife roadkills while facilitating regional connectivity. The results of these analyses can inform future construction and renovation projects.

27. STUDYING STEM DENSITY, ANIMAL ACTIVITY, ROAD PROXIMITY, AND INVASIVE PLANTS IN NYC FORESTS

Emily Hargous, Carol Henger, Lily Mleczko, Damonis Baker, Jesiree Nathaniel, and Karime Robles

Fordham University, Wildlife Conservation Society, Project TRUE, New York City Parks

This study researched animal activity in relation to stem density, forest maturity, road proximity, and invasive plant species. Typically, older growth forests consist of large trees in the overstory, fallen dead trees, and a low stem density. Newer growth forests have fast-growing trees and bushes that flourish in places with abundant sunshine, small tree circumferences, and a higher stem density. In well-kept new growth parks, plant life is rigorously protected and maintained due to human activity and park workers, which could result in an increase of biodiversity. Invasive species can be detrimental to animals and habitats, causing a difference in animal richness between sites. They often outcompete native plant species, and overtake resources. Roads that are near forests can be influenced by human activityas well. In this study, 15 cameras were placed across 5 different NYC parks. A 5 m radius wasmeasured at each site with the camera tree as the central point. Within the 5 m radius, all of the trees were counted and individually identified. The amount of invasive species was quantified using 1 m^2 plots. Animal activity and stem density were compared, resulting in a positive correlation between the two variables, supporting the hypothesis. Amount of invasive plants and animal richness were compared, with areas of more invasive plant species correlating negatively with animal species richness. Amount of invasive plants and stem density were compared with areas of higher stem density correlating positively with more invasive plants, supporting the hypothesis. Additionally, road proximity and animal activity were compared, resulting in a negative correlation between animal activity and distance to road, contradicting the hypothesis.

28. WHAT WE HAVE LEARNED FROM 10 YEARS OF MONITORING NESTING RAPTORS IN ORANGE COUNTY, CALIFORNIA

Dr. Riley Pratt

Irvine Ranch Conservancy, Irvine, CA

Raptors are important keystone predators in many terrestrial ecosystems. They are also sensitive to environmental change and are therefore considered good indicators of ecosystem health generally. Additionally, raptors are large and conspicuous animals, making them good candidates for monitoring programs involving professional biologists and volunteers. For over a decade, the Irvine Ranch Conservancy (IRC) and its partners have been monitoring nesting raptors across nearly 20,000 acres of the The Irvine Ranch Natural National Landmarks (IRNNL). The IRNNL encompasses nearly 90,000 acres of public open space in Orange County, California, and is managed for both biological conservation and public access. Results from this monitoring period suggest nesting activity of raptors is strongly and positively correlated with rainfall. Nest success is also negatively influenced by proximity to the urban edge, where raptors may be more exposed to disease and toxins (*e.g*. anticoagulants), but may also discover novel food resources. As such, the negative impact of urban edges on raptor nest success may be mitigated during extreme drought when prey items may be more abundant at urban edges. While prolonged drought may be primarily responsible for recent, steep declines in both the number of active nests and the percentage of successful nests observed, other factors may influence this dynamic.

29. MONITORING ALLOWS ADAPTIVE MANAGEMENT OF NUISANCE SPECIES IN URBAN ENVIRONMENTS

Max Tarjan[1], Yiwei Wang[1], Natalie Washburn[1], Catherine Burns[1], Joshua Ackerman[2], Caitlin Robinson-Nilsen[1], Cheryl Strong[3], and Don Edwards[4]

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California Gull (*Larus californicus*) populations in San Francisco Bay have increased dramatically over the past three decades. In this urban ecosystem, gulls frequently forage at local landfills and take advantage of other anthropogenic food resources. Gulls also prey on smaller and less abundant nesting water birds. California Gull population growth is a pressing concern for management of the San Francisco Bay estuary. Historically, California Gulls nested on levees and dry salt ponds, but 15,100 acres of salt pond habitat are being converted to tidal marsh as part of the South Bay Salt Pond Restoration Project. As restoration progresses, it is unclear how California Gulls will redistribute and how other water bird populations will respond to this rapidly growing predator population. Information on what drives gull population growth and how gulls respond to landscape changes will help predict the ecological impact of future tidal marsh restoration activities in San Francisco Bay. The San Francisco Bay Bird Observatory (SFBBO) leads a California Gull nesting survey each spring to collect data on all known breeding locations in the Bay Area. Movements in response to restoration are also tracked by re-sighting the 1,000+ gulls that were banded at local breeding colonies in 2008-2010. Over the past 30 years, SFBBO has documented a rapid increase from only 24 birds in the early 1980s to over 50,000 in 2014. This increase may have been facilitated by landfills and other anthropogenic food resources in a highly urbanized landscape. In the past five years, hazing efforts and abatement have successfully kept gulls from foraging at local landfills and nesting near sensitive species. From 2014 to 2016, populations declined to an estimated 38,040 breeding California Gulls. The causes of this decline merit investigation to better inform adaptive management of local and similar ecosystems.

30. THE USE OF CANINE SCENT DETECTION, DNA TESTING AND OTHER METHODS TO ASSESS THE DISTRIBUTION OF AMERICAN BADGERS IN WESTERN SAN DIEGO COUNTY

Cheryl Brehme[1], Devin Adsit-Morris[1], Heath Smith[2], Samrat Mondol[2], Samuel Wasser[2], and Robert Fisher[1]

[1]U.S.Geological Survey, Western Ecological Research Center; [2]Center for Conservation Biology, University of Washington

Wildlands, particularly upland habitats, are highly fragmented by roads and development in western San Diego County. Because of their large home ranges and sensitivity to effects of fragmentation, American badgers (*Taxidea taxus*) have been identified as a target species by local and state agencies for monitoring the functional connectivity of upland and grassland habitats. However, we had little information on badger distribution within San Diego County. In order to rapidly assess where badgers still persist in this area, we used a specially trained canine scent team (Conservation Canines, University of Washington) to conduct surveys for American badger scat. We surveyed for badger scat across 32 prioritized sites within San Diego County and two sites in southern Riverside County. Using a highly specific badger DNA test, we verified the scat collected to be that of the American badger at twelve of the sites. Many of these sites contained little to no other visible sign (digs, burrows, trails) and thus likely would not have been (or were not) identified as occupied by badgers using sign surveys alone. We continue to monitor sites using a combination of canine surveys, sign surveys, wildlife cameras, and a public outreach campaign. We found this combination of methods to be rapid, sensitive, reliable, economical for assessing the distribution of badgers in western San Diego. Future plans include bothdevelopment of a microsatellite DNA test to identify individual animals from scat that would allow us to estimate population sizes, monitoring core sites to assess seasonal activity patterns, potential use of radio-telemetry to identify significant movement corridors between upland habitats, and continued public outreach. The results will help to inform habitat acquisition, habitat management, and road mitigation strategies.

31. ADAPTIVE MANAGEMENT APPROACH: HUMAN ACCESS AND WILDLIFE ACTIVITY PATTERNS IN IRVINE RANCH NATURAL LANDMARKS

Courtney Aiken, Jutta C. Burger, and Riley Pratt

Irvine Ranch Conservancy, Irvine, CA

Camera traps provide researchers and conservation managers with meaningful information on the activity of wildlife and humans alike. For example, data from camera trap can be used to investigate the relative change in wildlife activity over time and test for relationships between wildlife and human activity. In turn, this information can be used to improve access and wildlife management. To better understand patterns of wildlife activity over space and time, and the relationship between wildlife and human access, we analyzed a decade worth of wildlife activity and human access data collected from 47 camera traps on the Irvine Ranch Natural National Landmark (IRNNL). The IRNNL encompasses nearly 90,000 acres of public open space and trails in Orange County, California, and is managed for both biological conservation and public enjoyment. Results show that activity for coyote and bobcat has decreased over time but only in the coastal portion of the IRNNL. Deer and mountain lion activity, in contrast, do not appear to be declining significantly. In addition, both coyote and mule deer exhibit strong seasonal shifts in activity across the landscape.Wildlife does show an acute, avoidance response to humans. For example, the presence of just 1-10 trail users is associated with a decrease in same-day wildlife activity compared to days without trail users. A more focused analysis of large access events found significantly reduced wildlife activity during and three-days after events with 100-600 participants compared to background access levels, and that wildlife shifted their activity into the evening hours. Large event threshold recommendations have been put in place limiting the amount of trail users on the open space at one time. Implication of these finding for access policy and future adaptive management will be discussed.

32. A web mapping application for tracking weed abatement as a land management tool

Amanda Eigner and Ken Devore

California Department of Fish and Wildlife, San Diego, CA

San Diego County is a hotspot for biodiversity while having a population of over 3 million people. Invasive species are considered one of the greatest threats to endangered species and can have detrimental impacts on native habitats. Urban areas may especially receive pressure of invasive plant spread from bordering homes, hikers, bikers, roads, and trailheads. California Department of Fish and Wildlife (CDFW) Region 5 manages over 40,000 acres of land in San Diego County. Land managers and biologists have to make important decisions on how to manage for invasive plants, often with limited resources through pesticides and mechanical removal. When CDFW completes a weed abatement application, a variety of information is collected such as methods, area covered, pesticide rates, target species being treated, the man power/time needed for the application and much more. Historically this data has been filled out on paper forms. An online data entry form was created to develop a database for this information and a web mapping tool was developed to record areas spatially. This has allowed for data to be more accessible, searchable, and standardized. Over 200 applications have now been mapped on CDFW Region 5 lands in San Diego County, making up over 500 acres. Creating a product that allows land managers and biologists to see and search historic weed abatement data visually could be useful in many ways. For example, it could be used to see how a treated area has changed over time, it may help plan applications at landscape levels, the data could be overlaid with hiking trails or sensitive species data to determine important areas being missed for treatment, and it could open up opportunities for future studies and research.

33. A Review of the invasive Shot Hole Borer: The challenges of Managing an Invasive Beetle in Southern California

Marcus Hubbell and Hans Sin

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Shot Hole Borer (SHB), an invasive beetle, has recently caused the die back of large stands of trees in Southern California, starting along the border in the Tijuana River near large urban human populations (San Diego, USA and Tijuana, Mexico). That specific infestation has caused the loss of over 1000 acres of riparian habitat. SHB, which reproduce within suitable host plant species, can damage the vascular system and may spread symbiotic fungal pathogens within the host plant, which can cause branch dieback and even plant death. SHB has currently over 50 host plants and the spread of the invasive beetle has been alarming for conservation efforts that can potentially be at risk. These conservation efforts include large mitigation areas for urban development that has impacted listed species. Already the SHB has caused widespread economic loses to the avocado industry, extensive destruction to Orange County Parks, and has infested and damaged large natural areas. Current monitoring efforts include looking at bored holes in host plants, and trapping efforts with traps with lures (Lindgren, Vane, bottle and sticky traps). Control of the invasive beetle has been limited on the landscape level and currently chipping trees and covering chip piles with tarps (to increase temperatures to kill SHB) is a method being used. Also inoculating host plants with systemic endophytes to kill the fungus is currently being researched. Challenges arise in coordinating efforts across agencies, various jurisdictions and the general public in data management, monitoring and control efforts.

34. Urban mule deer translocation: year one update

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Mule deer (*Odocoileus hemionus*) populations have been declining throughout much of western North America. In contrast, deer-vehicle collisions, landscape damage and nuisance complaints have increased in Utah and elsewhere throughout the West. This is driven in part by increasing expansion of communities into mule deer habitat as well as increasing use of these communities by mule deer, leading to situations of overabundant urban mule deer. By determining if translocation of overabundant urban mule deer is a feasible method to supplement declining wild populations while simultaneously reducing urban complaints, we could inform management decisions in western states. In 2014-2015, we captured 211 urban mule deer from Bountiful, Utah and fitted 100 with VHF radio collars. Fifty-two collared deer were released in the Raft River Mountains in Box Elder County and 48 collared deer were released in Big Wash in Duchesne County. We estimated the apparent annual survival rate of translocated urban mule deer, Bountiful residents' perceptions of urban mule deer pre-translocation, and costs of capture and translocation. Our preliminary results will document patterns in the apparent survival of translocated urban mule deer at 2 release sites. Ongoing studies in 2015-2017 will double the sample size for translocated deer, include a formal survival analysis, and conclude with a follow-up survey of Bountiful residents after the deer translocations have concluded.

35. Evaluating invasion predictions with physiological data

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Ecological niche models are often used in conservation and management practices to predict the potential for non-native species to invade a new habitat. Therefore, depending on these models to enact appropriate management plans assumes their accuracy, but most niche model studies do not provide any validation for their model outputs. South Florida holds the most invasive lizard species of anywhere in the world, and thus provides a unique opportunity to evaluate model accuracy by comparing niche model predictions to field data collected from established non-native populations. There are a total of 29 non-native lizard species established in Miami-Dade County, and we are developing ecological niche models for each species. Additionally, we are collecting physiological trait data on critical thermal maxima and minima of these non-native lizards, as these are known to be drivers of species range limits. We plan to compare these observed thermal limits to those predicted by the niche models. Whether the model outputs match the observed physiological data will influence how we interpret the resulting predictions of potential invasive range extent. For example, do we think that niche models produce accurate predictions of the fundamental niche, does the fundamental niche shift between native and invasive ranges due to subsequent adaptation in thermal tolerances, or are niche models simply poor predictors because factors other than climate determine native range limits? Such interpretations can have strong implications for how ecological niche models are used in non-native species management.

36. CONTROL POSSIBILITY OF CORVIDS IN URBAN ENVIRONMET– A TRAPPING EXPERIMENT

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Hooded Crows (*Corvus corone cornix* L.) have colonised and spread in many European cities in recent decades. They are often considered a pest due to their noise, spilling litter, aggression to humans and domestic animals, and predation on birds of urban environments. Consequently, the control and/or management of crow populations may become necessary in the future in many cities. The aim of this study was to compare the effectiveness of different trap types in catching crows and other corvids in an urban environment. We experimentally tested four types of traps (Larsen: side and upper door versions, Swedish trap and ladder entrance trap) at the campus of the University of Debrecen (Hungary) during the winter season. As bait, we used bread and live decoy birds. During more than 100 trap-days we caught more than 30 Hooded Crows, almost 250 Rooks (*Corvus frugilegus*), two Jackdaws (*Corvus monedula*) and one Magpie (*Pica pica*). The results showed that the ladder entrance trap and the side-opening Larsen trap were the most effective. We caught only juvenile Hooded Crows, and both juvenile and adult Rooks, likely related to the wariness of adult crows. We had many recaptures and some trap-happiness crows were experienced. Our study suggests that trapping may be an effective way to catch crows and that some trap types may be more efficient than others. We present detailed guidelines for the construction and operation of these traps, which experience will be important in urban environmental management, and in nature conservation and wildlife management.

37. WILDLIFE RESCUE BIKE innovated for Patrolling, Surveillance, Translocation & Transportation of Wildlife

Dr. Madhurita Gupta

Myvets Charitable Trust & Research Centre, National Institute of Wildlife Technology & Research, Mumbai, India

Conflict between Wildlife and Humans are increasing globally with the habitat destruction and the increase in the population of tigers, elephants and leopards in India. With the aim to develop a technology for safe handling of Wildlife – Human Conflicts and safe patrolling in the wilderness “Myvets Charitable Trust & Research Centre” developed “Wildlife Rescue Bike“. In most of the reported cases of Leopard rescue during conflicts majority of forest officials gets injured and there are incidences wherein villagers also got injured during the rescue operation while going near the leopards as conflict creates fear in the mind of people and they counterreact by beating the wildlife to death or by killing them directly. New technologies will revolutionize the way we handle the Wildlife–Human Conflicts and Endangered Mammals conservation at global level, it can be used as an effective and powerful tool for wildlife conflicts mitigation worldwide. The device has been used in India in wildlife terrain and is very effective to provide safety to the forest officials & wildlife Veterinarians during the Leopard – Human Conflicts, Night Patrolling and during tranquilization of wild leopards & tigers for rescue. KEY FEATURES OF WILDLIFE-RESCUE-BIKE 1. Close monitoring , patrolling & surveillance of wildlife in protected Areas, 2. The Wildlife Rescue Bike will give 360 Degree panoramic view for darting, 3. Contemporary & dynamic design, 4. The bike is covered from all the sides with iron-net to ensure the protection of forest guard from the attack of wild animal.

38. "Better than Pokémon” - Engaging the public through citizen science and BioBlitzes

Sam Kieschnick

Texas Parks and Wildlife, Dallas, TX

When the public is actively engaged in the outdoors, they are more likely to be aware of and appreciate wildlife. One way that the public can become engaged is to participate in a BioBlitz. A BioBlitz involves citizen scientists and professional biologists in the documentation of all species in a specific area and time frame. An example of this occurred in Fort Worth, Texas at Tandy Hills, a 160 acre city park, where in one week in April, 126 participants documented 524 species in 2473 observations. These observations were then verified or identified by 152 other naturalists around the world. This event provided tangible results that are used as a management tool for areas of high biodiversity and public interest. Utilization of the citizen science tool, iNaturalist, was paramount to the success of this event and should be highlighted for future public events. iNaturalist inspires an instinct of exploration and may guide future generations of naturalists and biologists.Urban biologists should consider implementing a BioBlitz for both public engagement and for citizen science data collection.

39. Effect of Habitat Fragmentation on Snakes in the Southern California Chaparral

Andrew Powers and Dr. Tim J. Karels

California State University, Northridge

Los Angeles is one of the largest and newest urban areas in the world, and through this rapid urban sprawl has created many scattered habitat fragments. These habitat fragments can have negative consequences on wildlife diversity and dispersion. Studies of habitat fragmentation have focused on lizards, mammals and birds, but rarely snakes. Many of these groups, such as lizards, have been chosen for their high visibility and conspicuous nature. Studies have shown that in areas of high fragmentation and urbanization, lizard diversity becomes lower than in unfragmented areas. However, this trend might not carry across all reptile groups. Snakes are an ecologically important group as primary predators on rodents and nesting birds in areas that other predators cannot reach. They are long-lived, habitat specific, and are more vulnerable to human interference than other reptiles. I will explore the relationship between snake diversity and habitat fragmentation in Thousand Oaks, California. Previous studies on snake diversity and habitat fragmentation were conducted in 100 year old forest patches. My study will be the first to focus on newly fragmented 30 year old chaparral patches. I will capture snakes, identify species, and I will record mass, length and sex in order to quantify snake diversity and population composition in 25 large and small patches. I expect to find differences in snake composition for patch size, as many species are selective not only in their preferred microhabitat but also in their prey choice. In addition, I expect large snake diversity and size will decrease as patch size decreases. I also hypothesize more recently fragmented patches will have higher diversity over older patches. My novel study will help to elucidate the challenges local wildlife are faced with through urbanization so we, as biologists, may be better equipped to protect them.

40. Behavioral flexibility in captive raccoons (*Procyon lotor*)

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Innovative problem solving and behavioral flexibility are important cognitive abilities of many successful species. Animals capable of innovative problem solving are more likely to experience benefits like increased mating success and adapt to the increasing demands of living in peri-urban and urban landscapes. Here, we investigated which mechanisms enable the generation of innovative and flexible behaviors and if the widespread success of an adaptive generalist carnivore could be due in part to having these advanced cognitive traits. Raccoons are anecdotally understood to be widely successful and clever in a large number of habitats and situations, especially in the procurement of anthropogenic food, but very little work has been done to assess their behavioral flexibility. We gave twenty raccoons a multi-access puzzle box in captivity to determine whether raccoons exhibit innovation and behavioral flexibility, defined as multiple occurrences of distinct innovations. Over two-thirds of raccoons tested were not only innovative, but also behaviorally flexible. We identified behaviors predictive of success at various stages of the problem-solving process, including exploratory diversity, persistence, and neophobia. This study informs our understanding of behavioral flexibility, provides evidence consistent with both cognitive hypotheses related to adaptive behavior, and contributes to knowing which mechanisms could be driving species success in human-altered habitats.

41. Comparative study on pre and post monsoon waterbird diversity in Nijhum Dweep and Domar Char, Noakhali, Bangladesh

Shuvo Kumar Saha

University of Dhaka, Bangladesh

The study was conducted on the pre and post monsoon comparative diversity of the waterbird of the Domar Char and Nijhum Dweep, from March 2015 to November 2015.The study was carried out by direct observation through direct count method. A total of 50 species of waterbird belonging to 4 orders, 8 families and 30 genera were recorded during the study period. All the 50 recorded species of waterbird highest number of species (n=40) recorded during the post-monsoon study period and lowest number of species (n=36) recorded during the pre-monsoon study period. Of the 50 species of waterbird, 13 (26%) species were found as residents of Bangladesh and 37 (74%) species were found as migratory. Among the 13 resident waterbird species, 9 (69.23%) were common resident, 3 (23.07%) were uncommon resident and 1 (7.69%) was rare resident. Of the 37 migrant waterbird species, 27 (72.97%) were common winter migrant, 4 (10.81%) were uncommon winter migrant, 2 (5.40%) were rare winter migrant and 4 (10.81%) were summer migrant. Regarding the relative abundance.19 were identified as rare (38%), 17 were uncommon (34%), 5 were very common (10%) and 9 was common (18%). In the study area 6 species were mud probing (12%), 7 were surface feeder (14%), 13 were mid mud probing (26%) and 24 were water divers (48%).From the study area 41 species (82%) of waterbird were identified as Least Concern, 7 species (14%) were Near Threatened, 1 species (2%) was Vulnerable and 1 species (2%) was Endangered. Of all the species, one was Endangered (Spotted Greenshank *Tringa guttifer*) and one was vulnerable (and Indian Skimmer *Rynchops albicollis*) and 7 species were near threatened. Species varied considerably in different study months. Speceis richness was in highest peak in March (66%) and least in November (48%).

42. A GPS tracking study of movements and fine scale foraging habitat selection during breeding by the threatened Black Harrier *Circus maurus*

Siamak Tavakoli

Brunel Innovation Centre, United Kingdom

The Black Harrier (*Circus maurus*) is a rare southern African endemic raptor, considered as threatened, with an estimated total world population of less than 1000 mature breeding birds. Recent population declines have been observed, but the reasons are not yet well understood. This ground-nesting species breeds mainly in the Fynbos biome of south-western South Africa. Black harriers have lost as much as 50% of their preferred natural habitat to the spread of agriculture, alien vegetation and urbanization in the last 100-150 years. Over 90% of the natural vegetation in lowland areas of the western and south-western coastal plains has been transformed by agriculture. Knowledge on how habitat loss and fragmentation are modifying or limiting the breeding distribution and success of the black harriers are crucially lacking, as well as the influence of those on dispersal and connectivity among remaining populations. The relationship between habitat characteristics and availability of prey (which may be mediating suitable habitat loss) is also unknown, but this aspect is critical to evaluate habitat needs for all species at a wide scale. With this proposal we aim at filling these knowledge gaps in order to better understand conservation needs for threatened Black harriers. The aim of this project is to use GPS tracking devices to: 1) Determine the home ranges, movements and fine scale habitat selection by foraging breeding Black Harriers during breeding. We will determine and characterize in detail the habitats (in terms of their vegetation type, micro-habitat characteristics and prey abundance) used by foraging harriers during breeding and compare those with that of other habitats that harriers do not use for foraging. 2) Determine daily activity rhythms and changes in movements / space use as breeding progresses (from incubation to chick rearing and until the post-fledging period).

44. Wild Pig Management in Municipal Parks-Trapping and Stakeholder Engagement Case Study

Brett Johnson

Dallas Park and Recreation Department, Dallas, TX

Wild pigs (*Sus scrofa*) are an invasive species that are quickly adapting to urban environments. The damage caused by the pigs is the same seen in rural areas, but the management options are significantly different. Within the city, there are a wide variety of impacted stakeholders that are interested in the management of wild pigs, especially on publically owned property. In March of 2016, the Dallas Park and Recreation Department started a pilot project to trap and remove wild pigs on a select number of park properties. Through the success of the pilot project, the program is being expanded department-wide in 2017. Stakeholder identification and engagement, establishment of humane treatment protocols, accountability standards, encouraging media relationships, and public outreach were all significant portions of the Department's wild pig management plan. To date, pigs have been successfully trapped, damage on trap location parks is significantly reduced, and media coverage has been positive in nature. The process of successfully implementing a plan including stakeholder identification and the eventual trapping of wild pigs will be discussed.

45. Attributes of Urban Environments Can Promote Increased Carnivore Community Diversity: Bakersfield, CA as a Case Study

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Greater environmental complexity, particularly with regards to habitat attributes, can produce greater niche diversity and consequently increased species diversity. Furthermore, conditions in urban environments can reduce competitive interactions thereby facilitating local coexistence, which also can result in increased species diversity. In Bakersfield, California, such effects are evident in the community of carnivores present. Fifteen carnivore species have been documented in this urban environment. Of the 15 species, 9 are considered abundant, 4 are more rare, and 2 are primarily visitors in the urban environment. Prior to urbanization, saltbush scrub, narrow riparian corridors, and agriculture were present with each habitat type supporting a different suite of carnivore species. The urban environment of Bakersfield includes all of the species found in these habitats plus several additional "synanthropic obligates" that only occur in the urban habitat. Irrigated landscaping including shrubs and trees, man-made structures, and anthropogenic food sources result in increased availability and diversity of vegetation, habitat structure, cover, and food compared to the non-urban habitats that were present previously. Also, superabundant resources, abundant cover, and numerous refugia in urban habitats reduce both interference and exploitative competition, particularly for smaller species, and this can facilitate coexistence with larger species and can even enhance the abundance of some smaller species compared to that in natural habitats. A particularly interesting effect in Bakersfield is the co-occurrence of 5 canid species whereas usually no more than 2 are present in any of the original non-urban habitats. The carnivore community in Bakersfield is opportunistic, but serves as an example of how urban environments might actually enhance regional biodiversity for certain groups of species. Also, the presence of robust urban populations for many of the species could have important conservation implications as natural habitats in this region continue to decline.

46. The Pigeon and the Pea: what you don't know can hurt you

Cathy Boyles

Dallas/Fort Worth International Airport, TX

In 2014, nine bird strike events involving multiple birds, effect on flight, or aircraft damage involving rock pigeons (pigeons) occurred at DFW Airport within a three-month summer timeframe. Despite a "Zero Tolerance" policy for their presence, pigeons continued to be stubbornly attracted to specific areas of the Air Operations Area (AOA) during the summer months. There were no discernable attractants associated with these areas. In July 2014, undigested seeds in pigeon crops were collected from depredated birds exhibiting feeding behavior on these areas of the AOA, as were crop contents of pigeons involved in aircraft strikes. A study of the seeds resulted in identification and eventual discovery of a highly-attractive food source on and near DFW Airport's AOA, which resulted in a further investigation to determine whether other plants attractive to wildlife, especially birds, were growing on the AOA.The study included plant identification concurrently with seed identification from depredated and aircraft-struck crops of pigeons, the species involved in most damaging strikes at DFW Airport, and mourning dove (dove), the most commonly-struck species, through Calendar Year 2015. Results to date include: the identification of over 30 species of plants that are highly sought-after as a food source; documentation of an adaptive response to mowing in two species of plants; justification to revamp the airport's mitigation strategies; and a foundation has been laid for continued education of DFW airport staff to identify and control these plants. The flora study to document the responses to intensified turf maintenance continues.

47. Movement differences and patterns of space-use of white-tailed deer among natural and built environments of Fire Island National Seashore

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We used radio-telemetry and trail cameras to assess movement patterns of white-tailed deer among six natural areas and six built areas of Fire Island National Seashore. We deployed a total of 48 GPS radio-collars on adult female white-tailed deer from 2014 until 2016. Collars were programmed to collect activity and locational data from before dusk until after dawn, coinciding with peaks in deer activity. Collar duty-cycles were programmed for a single year deployment with a 45-minute GPS fix interval. Using Very-High-Frequency (VHF) signal tracking, we triangulated the locations of collared deer weekly and identified daytime resting locations. In addition, ten trail cameras were deployed in the Otis Pike High Dune Wilderness Area from 2014 until 2016 to assess deer movements. Twenty-five additional cameras were deployed in 2016 in a spatially explicit capture recapture (SECR) array to compare estimated daily movement rates and space-use of deer against similar estimates made from radio-collared deer. Radio-telemetry indicated high site fidelity among adult female deer regardless of capture location. We observed one apparent migration between a natural and built area 9,000 meters apart, and one apparent migration between two built environments 6,000 meters apart. Of the remaining collared deer, those predominantly using built environments exhibited overall displacement movements of 900 meters; deer in natural environments exhibited overall displacement movements of 1,100 meters. Initial analyses suggest shorter, more frequent movements by deer in built areas than natural areas. Daytime resting locations in built areas were frequently beneath houses, beneath boardwalks, between structures and in small groves of trees. In natural environments, daytime resting locations were predominantly in contiguous patches of maritime holly (*Ilex opaca*) forest, sparse pine (*Pinus rigida*) groves or in the salt marsh. Our findings have important implications for management of deer on coastal barrier islands with interspersed land uses.

48. Using citizen-science to inform urban canid management in Madison, WI

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Urban landscapes have diverse stakeholders with a wide range of attitudes and opinions towards wildlife. This presents urban wildlife managers with unique challenges, especially when it comes to charismatic wildlife species. Wild urban canids—especially coyotes—have been the subject of much interest throughout North America in recent years. Our research aimed to validate and equip urban wildlife managers with a novel strategy to both inform management decisions and engage stakeholders. In 2015, we used iNaturalist to collect citizen-generated location data for red foxes and coyotes in Madison, WI. We concurrently captured, radio-collared, and tracked 9 red foxes and 11 coyotes in the same area and over the same period of time. We compared both iNaturalist and radio-telemetry locations to identify how well iNaturalist locations overlapped with known canid locations to identify factors that led to a positive relationship between the two inherently different location-data sets. We had nearly 600 unique individuals report almost 900 red fox and coyote observations. Preliminary results suggest that roughly 30% of our radio-location data overlapped with iNaturalist observations for both red fox and coyote. Greatest overlap between iNaturalist and radio-location data for both foxes and coyotes occurred in areas with high-human density; conversely, there was minimal overlap in natural areas. Despite our radio-location data that indicated greatest canid activity occurred during nocturnal periods, most iNaturalist observations were recorded during crepuscular hours. In addition to location data, we asked observers to report additional information like distance to observed animal and canid's reaction upon seeing observer. This data was used to better understand the interaction between the observer and observed canid. iNaturalist reports appear to show where humans most often interact with red foxes and coyotes, rather than the true ranges of these species. Understanding this relationship may inform how iNaturalist can be used as an urban wildlife management tool. Recognizing factors that may lead to human-canid interactions could be important to managers interested in proactively avoiding conflict with wild urban canids.

49. Anticoagulant rodenticides cause systemic immuno-physiologic perturbation in urban-associated bobcats (*Lynx rufus*) as revealed by genome-wide transcriptional patterns

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Anticoagulant rodenticides (ARs) are the most common pesticide used to target pest rodent populations worldwide. Yet as indiscriminate poisons, ARs threaten non-target species, especially predators that rely on rodents as staple prey. While AR-induced mortality has been detected in numerous nontarget species, perhaps more concerning is accumulating evidence that chronic, sub-lethal exposure can have profound negative impacts at the population level. For example, AR exposure in peri-urban bobcats in Los Angeles, CA has been separately linked with both systemic immune dysregulation and frequent mortality as caused by an ectoparasitic disease, notoedric mange. To elucidate molecular mechanisms underlying these observations, we assessed the effect of AR exposure on genome-wide expression in peripheral whole blood of wild-captured bobcats. We conducted RNA-seq on samples for which AR exposure was detected (n = 26) or absent (n = 26). We find conclusive evidence of associations between AR exposure and differential expression of genes involved in the endoplasmic reticulum stress response, toxin metabolism and adaptive and innate immunity. Specifically, we observe down-regulation of genes associated with innate immunity and the pro-inflammatory response; up-regulated genes were associated predominantly with T-cell mediated immunity and ER stress. Further, AR exposure is associated with an overall decrease in transcripts associated with monocytes (particularly immature) and memory/plasma B cells, and a relative increase in transcripts associated with naïve/immature B-cells and CD4+ and CD8+ T cells. Collectively, our results suggest that chronic AR exposure alters innate and adaptive immune capabilities, and triggers ER stress, and therefore, may pose a substantial threat to small populations facing additional challenges like disease. This study demonstrates several cellular and molecular pathways by which a sublethal toxicant can nevertheless impair fit ness in a free-living carnivore, and underscores the importance of pairing novel genomic techniques with free-ranging field wildlife studies to understand cryptic effects of environmental stressors.

50. Bats on the Bayou - Opening Doors to Urban Wildlife Planning

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Bats are not usually charismatic wildlife species that create positive interactions in urban planning; but in Houston, bats are opening doors. Downtown Houston's Waugh Drive bat colony was considered a nuisance and steps were taken to evict the bats from bridge crevices. In 2005, at the urging of Texas Parks & Wildlife (TPWD) urban wildlife biologists, City of Houston Parks Department proposed developing a nature-related recreational area centered around the Waugh Drive colony of approximately 300,000 bats. TPWD organized a group of trained volunteers to begin observing and researching the colony to determine typical bat behaviors and seasonal activities in preparation for public outreach efforts.The Houston Area Bat Team's research and resulting public engagement led to support for bat protection guidelines implemented in recent bayou channel renovations near Waugh Drive colony and ongoing bat management policies for colonies residing in over 50 other area bridges. The bat team is branching out into a larger citizen science project to collect data, including using Doppler radar to find and ground truth unknown bat roost locations and identify seasonal use patterns, enhancing the bat roost database for the region. Planning consultants and governmental agencies are utilizing the bat team's data to design/redesign roadways and work around various bat colonies. Urban areas often lack natural outdoor recreation areas that are easily accessible to the public. Protection of urban bat colonies can provide easily accessible green space, nature tourism opportunities, re-connection to nature for city residents, and places to conduct research to better understand urban wildlife.In addition to data collection, Houston Area Bat Team members give educational talks and staff booths at events. Due to their valuable volunteer efforts, bats are highly visible and are included in regional planning.

51. How to Get People to Care About Your Research #2: Photos & Video

Kate Kuykendall[1] and Zach Behrens[2]

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Whether your research subject has an image problem or you just can't get the public (or funders!) to care about your work, strong and compelling images may be able to help. Public engagement is driven by strong images and good storytelling. And (mostly) good things happen when the public actually cares about your research -- your work will be more likely to influence decision-makers, drive positive behavior change, and even attract funding. This session will focus on what makes an image compelling, how to get compelling images, and how to deploy them once you've got them. There will be a special tangent on why you should invest in good graphics rather than that super complicated chart in your PowerPoint that nobody understands except other researchers!

52. No free lunches: foraging at the urban edge leaves caracals (*Caracal caracal*) vulnerable to cars, poisons, and poachers

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If the urban edge is resource abundant, urban-adapted carnivores may forage disproportionately in these resource hotspots. However, the attraction of carnivores to forage close to human-dominated landscapes can increase human-wildlife conflict and increase the vulnerability of carnivores to anthropogenic threats.We investigated the spatial ecology, diet, and mortality of caracals (*Caracal caracal*) in the urban landscape of Cape Town, South Africa. In Cape Town, caracals inhabit open space fragmented by extremely variable types of human disturbance, ranging from sparsely populated agricultural fields to high-density informal settlements with up to 46,000 people/km^2. We radio-collared 26 caracals (10 females, 16 males) and monitored their movement and diet. We investigated more than 500 GPS clusters for prey remains and resting beds, and assessed contents of more than 600 caracal scats. We identified sources of mortality by necropsying more than 40 radio-collared, tagged, and opportunistically found individuals. We observe that caracals are structurally isolated in the study area by dense urban development, and that foraging disproportionately occurs close to the urban edge. Urban caracals have a wide avian and mammalian prey base that includes domestic species, which is a frequent source of human-wildlife conflict in the city. Vehicles, pollutants, lethal control, poaching, and pathogens inflict high mortality, especially for subadult males. Early analyses suggest annual survival for adults is approximately 50 % and 17% for subadult males. Understanding both the benefits and detriments of the urban interface for urban-adaptable species is essential to mitigating threats and to conserving species as urban areas expand.

53. Cities and citizens taking the pledge to help wildlife: re-envisioning our backyards, schoolyards, businesses, transportation infrastructure and more as wildlife habitat and corridors

Beth Pratt-Bergstrom

National Wildlife Federation, CA

Imagine transit stops in Los Angeles creating a native garden path across the city for birds and butterflies. Or a frog pond in every schoolyard, a living biology class that also increases California's native amphibian population. Or a series of apartment buildings with edible hanging gardens that feed both people and pollinators. The National Wildlife Federation has been considering the question of increasing connectivity for both wildlife and people in urban areas, especially through the lens of utilizing its existing network in its Garden for Wildlife Program, which helps people restore habitat and wildlife populations to cities, towns and neighborhoods. Since 1973, the program enrolled over 200,000 spaces representing 1.5 million acres as Certified Wildlife Habitats in suburban yards, schools, campuses, corporate properties, farms, parks and more. Studies have shown this program and its participants make a difference in terms of its conservation, climate change, and sustainability values—and demonstrated that converting these spaces at scale can have great impacts in all three areas. This session will discuss how we can utilize at scale private and public spaces, and existing human infrastructure, to return greenspace and connectivity to the urban environment—to benefit both wildlife and people. Examples of programs that facilitate public participation in this area will be presented, such as the Community Wildlife Habitat Program (and case studies in enrolled cities like Austin, Baltimore and Seattle), the Mayor Monarch Pledge (cities like Oakland), and Million Pollinator Challenge (in partnership with USFWS).

54. Use of molecular tools in understanding crop raiding patterns and patterns of elephant mortality in relation to land use and urban areas in north-west India

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Wildlife Institute of India

Habitat fragmentation, degradation and land use changes impact Asian elephant (*Elephas maximus*) populations and cause elephants to stray out of the forests, crop raiding, human deaths and retaliatory killing of elephants as there are human habitation in and around Protected Areas. The present study is aimed to gain understanding of crop raiding patterns by using molecular tools to ascertain whether crop raiding is a random process or few individuals are frequent crop raider in north-west elephant habitat in Uttarakhand, India. 28 point semi-structured questionnaire survey was carried out in 34 locations stratified in six zones along the Rajaji Tiger Reserve. A total of 90 respondents dependent on agriculture were interviewed. Of the geo-referenced faecal samples (n =2538) collected as a source of DNA, a subset (n =88) was amplified across eight microsatellite and one male specific loci for identification of unique individuals. It was observed that 64.7% and 85.3% of settlements under regular crop raiding (n=34) were situated within 500 m and 1 km from the RTR boundary respectively. A total of 11 combinations of five commercial crops (paddy, wheat, sugarcane, maize and mango) were found to be cultivated around RTR. Crop raids were highest along the southern boundary (mean raids per year=80.26) compared to other parts of the RTR. Mature crops of paddy, wheat, sugarcane and maize were raided more frequently than semi-mature and immature crops. Questionnaire survey also revealed that winter was the primary season of crop raiding. Raids were most frequent during 9 pm to 12 am. Crop raiding was more frequent on southern part of RTR during winter and mature crops were highly impacted. We discuss utility of molecular tools in tracking crop raiding elephant individuals. We also discuss mortality in elephants (n=119) in relation to land use patterns and urban areas.

56. Improving Connectivity for Mountain Lions on California Highway 17 Corridor Through Collaboration with Multiple Partners

Pathways for Wildlife, Caltrans, Land Trust of Santa Cruz County, Midpeninsula Regional Open Space District, and Peninsula Open Space Trust

The Santa Cruz Mountains are becoming increasingly isolated by habitat fragmentation due to roads and housing developments, making it difficult for wildlife to travel in and out of the mountain range. A total of 450 animals have been recorded hit on Highway 17 in the past 8 years from the town of Los Gatos to the Scotts Valley (Caltrans roadkill data, Pathways for Wildlife). Each year, 1 or more mountain lions have been hit on Highway 17. Highway 17 currently lacks the appropriate culverts and bridges for animals to cross underneath the highway. In September 2013, the Land Trust of Santa Cruz County, Midpeninsula Regional Open Space District, Peninsula Open Space Trust, and Pathways for Wildlife joined as project partners to work with collaborators; Caltrans District 5, the UC Santa Cruz Puma Project, the Department of Fish and Wildlife, and Santa Clara County Parks to identify the best locations for potential wildlife crossing structures on Highway 17. Four different types of data were used to determine where to install the culvert; 1) Modeling from the UCSC Puma Project & BACL, 2) Caltrans Roadkill Data & Roadkill Surveys conducted by Pathways for Wildlife, 3) UCSC Puma Project: Radio Collar Data and 4) Camera Monitoring by Pathways for Wildlife. The data collected from this project has identified two locations in which to install wildlife crossing structures, which are now both in design phases. The installation of crossing structures would greatly enhance the ability for wildlife to safely cross under Highway 17 and help maintain healthy animal populations by increasing the ability for genetic flow to occur between populations. Data from this project has also resulted in protecting large tracts of habitats as part of the wildlife linkage. The success of this project is largely due to the project partnerships and collaborative efforts.

57. The importance of the Los Angeles urban forest for sustaining migratory bird populations

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The Los Angeles metropolitan area (LA) is home to one of the most diverse urban forests on the planet with estimates suggesting nearly 600 native and non-native tree species are distributed throughout the region. The large diversity of native and non-native trees in the urban environment is likely responsible for attracting a diverse assemblage of wintering migratory birds, which are predominantly native species that spend upwards of seven months of the annual cycle (October – April) in the region foraging on the surface of trees for food items including insects and fruits. While it remains clear that LA is a hotspot for urban biodiversity, it is unknown exactly which factors influence interactions among birds and trees throughout LA. This is important to understand to help improve management of the LA urban forest for sustaining a major component of southern California biodiversity, the wintering bird community. During the winter of 2015 and 2016, we found strong support that native trees were highly preferred as foraging substrates by wintering migratory birds while non-native trees were avoided. We are building on our initial work by continuing to quantify patterns of bird and tree diversity, and describing tree-species preferences by wintering birds across a socioeconomic gradient throughout LA. More specifically, we have the following objectives within our study: (1) determine patterns of bird foraging success on varying tree species, (2) uncover disparities in the diversity of birds and trees along a socioeconomic gradient, and (3) investigate drivers, whether they are socioeconomic or 'natural', which may influence patterns of bird and tree diversity throughout the city.

10. Urban coyotes

"Wildlife Watch" A leadership response to urban wildlife conflict

Lieutenant Kent Smirl

California Department of Fish and Wildlife, Claremont, CA

Human-coyote conflicts continue to increase in the cities and suburban areas of southern California, as are the number of attacks on humans. In response to this public safety concern, the California Department of Fish and Wildlife developed a concept known as “Wildlife Watch”, which emphasizes agency leadership and community education. Wildlife watch has been utilized by cities in Orange and Los Angeles Counties, and the program’s success is fueling greater expansion throughout southern California. The concept of “Conservation Coaching” is discussed as a leadership tool used in guiding an agency and communities through a learning process in basic ecological principles, *i.e*. life history, predator prey relationships, habitat and attractants to effect human behavior change in terms of coyote awareness, accountability and preventative measures. Conference attendees will learn how to initiate a Wildlife Watch program within their respective agencies and communities with an emphasis on saving time and money.

Flight Initiation distance as an indicator of relative coyote boldness across and urbanization gradient

Katie Robertson[1], Shane McKenzie[2], Chris Anchor[3], and Stan Gehrt[1 2]

[1]The Ohio State University, Columbus, OH; [2]Max McGraw Wildlife Foundation, Dundee, IL; [3]Forest Preserve District of Cook County

To enter and persist in urban locations, some coyotes (*Canis latrans*) have adjusted their behavioral patterns to avoid negative human encounters while still accessing resources found within city limits. Depending on the individual, an animal may behave more risk-averse (*i.e.*, shy) or risk-prone (*i.e.*, bold). The cost-benefit ratio of behaving boldly varies depending on the type of habitat an animal inhabits. We hypothesized that in Chicago, for example, heavy human activity levels and a dynamic habitat infrastructure would better support a bolder individual; shy individuals would be more stressed by the environment and less likely to locate novel resources cities provide. One way to quantify relative boldness of an animal towards people is through flight initiation distance (FID) testing. FID is a measure of how close a human can approach a resting animal before the animal flees. For this study, it was assumed that individuals with shorter FIDs were bolder than those with long FIDs. Radiocollared coyotes from forest preserves (n=24), suburbs (n= 17), and urban locations (n=8) were tested and their FIDs were compared to assess whether there was a trend in relative boldness toward people across the urbanization gradient. As urbanization decreased, the average FID increased (r^2= 0.325; $p<0.0001$). Coyotes from downtown Chicago, on average, had the shortest FIDs of all animals tested. This supports the idea that while there is little pressure to exhibit a specific behavioral syndrome in more natural areas, urban areas may contain various stressors, constraints, and resources that better support individuals on the bold side of the spectrum. Other behavioral and physiological methods of quantifying behavioral syndromes in coyotes are currently ongoing and will later be compared to the FID test results.

10. Urban coyotes

Landscape and socioeconomic predictors of urban coyote distribution: New York versus Chicago

Christopher Nagy[1], Mark Weckel[2], Seth Magle[3], and Mason Fidino[3]

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Magle *et al.* (2015) examined the distribution of coyotes and other medium-sized mammals in relation to landscape and socioeconomic factors in Chicago using camera traps. They found that socioeconomic factors (*e.g.*, mean household income, age of neighborhood) were equally as important as habitat factors (*e.g.*, patch area, amount of forest, grassland, *etc*.) in predicting site occupancy. The Gotham Coyote Project (GCP) has used camera traps to monitor wildlife in New York City (NYC) since 2010, in particular focusing on the expanding coyote population there. In 2016, the GCP adapted their camera deployments to Magle *et al*. 's protocol to allow for comparison between the two cities and to test whether similar socioeconomic factors played an important role in the distribution of urban mammals in NYC as well as Chicago. We present the results of this Chicago-NYC comparison regarding coyotes (other species' analyses are in progress) and describe recent developments in the expansion of coyotes from mainland NYC to Long Island, including the first recorded successful den on Long Island.

Engaging the Public in Urban Wildlife Research: A Case Study using Coyote and Red Fox

David Drake and Marcus Mueller

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The UW (University of Wisconsin) Urban Canid Project is a research and public outreach project that involves live-trapping and radio-collaring coyotes and red foxes in Madison, Wisconsin. One of the objectives of our project is to engage and educate the public about urban coyote and red fox ecology, research, and management. In order to engage and educate the public, we have an active Facebook page dedicated to our project, ask the public to report sightings of coyote and red fox through our project's iNaturalist page, and invite the public to join us as we check traps. We have over 2,600 followers on our project's Facebook page, have had nearly 600 unique individuals report almost 900 observations of coyote and red fox via iNaturalist, and have had more than 400 members of the public join us as we check traps for coyotes and red fox. Each piece of our outreach effort offers something different yet complementary. We use our Facebook page as the primary portal to interact with the public and to disseminate information about our project's progress and other timely information (*i.e*., how residents of Madison can prevent coyote attacks on their pets). The iNaturalist page is a citizen science effort that allows citizens to engage with our project by sharing their sighting of a coyote or fox and contributing location data that supplements our radio location data. Interacting with the public when checking traps offers us the greatest ability to educate the public because we can show first-hand our research but also answer questions and engage in meaningful conversation. Ultimately, the sum of our outreach efforts increases knowledge and tolerance for urban coyotes and red fox.

10. Urban coyotes

Behavior and Genetic Comparisons Among Coyotes Along An Urban-Suburban Gradient.

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Urban conditions such as habitat fragmentation, development, increased road density, human disturbances, and food availability may cause some species to alter their behavior to exploit the landscape. Many behaviors have been linked to specific gene regions and behavioral differences between individuals living in different environments can also have a genetic component. However, although predators may react differently than prey species due to life history strategies and interactions with people, research on behavioral differences of predators in urban ecosystems is lacking. Our objective wasto determine if urbanization affects the behavior and genetics in coyotes living along a suburban-urban gradient. First, we hypothesized that coyotes have unique personalities and will exhibit different individual behaviors, particularly for boldness and aggression. Secondly, we hypothesized that environmental conditions will select for certain behaviors that are under genetic control. To test these hypotheses, we quantified coyote behavior in an extreme urban-suburban gradient and determined if there were allelic differences by population in dog behavioral gene regions. Behavioral data, such as the actions of a coyote during capture, processing, and an arm test, were recorded for over 80 Chicago MetropolitanArea coyotes during 2013-2016. For each captured coyote, a minimum of two observers assigned a 1-7 score for bold and aggression, and eight gene regions were sequenced from blood samples for a total of 20 single nucleotide polymorphisms (SNPs) and two microsatellites. We found differences between dog and coyote sequences, as well as behavioral differences between coyotes and habitats. To better manage coyote populations in cities, it is important to understand the relationship between urbanization and predator behavior. Understanding the mechanisms, both environmental and genetic, behind boldness and aggression is crucial towards mitigating human-coyote conflicts.

Movement and Activity of Coyotes in a Coastal Urban Landscape

Theodore Stankowich and Rita Collins

Department of Biological Sciences, California State University, Long Beach

Once considered rare, negative coyote interactions and conflicts in urban areas have increased precipitously in the past two decades, and attacks on household pets are even more common. As suburban neighborhoods sprawl into formerly wild areas, suitable coyote habitat shrinks, and neighborhoods often border the steep, brushy areas preferred by coyotes. Since 2016 we have been monitoring the movement and behavior of coyotes along the San Gabriel River in Long Beach, CA using motion activated trail cameras and carnivore lure. We have also exposed captive coyotes at a USDA facility in Utah to spraying skunk models in order to test their ability to learn to avoid noxious prey and to explore the potential of training wild urban coyotes in a similar way to avoid domestic pets. Our camera data show significant use of the minimal natural landscape features and some critical artificial connectors (e.g., drainage pipes) to move along a large contiguous territory in order to access isolated neighborhoods where potential conflict with humans may occur (*e.g.*, attacks on pets or threats to humans). Experimental data show that coyotes can be trained to avoid skunks and we plan to move forward with similar tests with model cats that can spray skunk oil. More intensive monitoring across larger transects, targeted radio-collaring and PIT tagging of individuals, and experimental testing with spraying models in the field will be critical to alleviating human-coyote conflicts.

10. Urban coyotes

Diet of coyotes in southern California at the urban-wildland interface

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The ability of coyotes (*Canis latrans*) to thrive in urban and suburban settings has led to increasing conflict between coyotes and humans. Although multiple factors have contributed to the success of coyotes in southern California, e.g., habitat diversity, mild climate, abundant anthropogenic foods, it is conceivable that high densities of feral and free-roaming cats (Felis catus) associated with trap-neuter-release (TNR) practices also attract and subsidize coyote populations. The aim of our project, initiated in 2016, is to determine the effect of cat colonies on coyotes by examining the diet of coyotes collected throughout the region as roadkills and through private and government efforts to control nuisance animals. We use traditional stomach-content analysis (hard-part analysis) to identify prey remains in the stomachs of coyotes. We also use stable isotope analysis and molecular genetic methods (PCR) to screen stomach contents for presence of cats, non-native rodents, and representative wildlife species. The age of coyotes is estimated by visual inspection of mandible tooth wear and cementum annuli analysis of lower canines. We will examine the relationship between consumption of feral cats by coyotes and the density of feral cat colonies in the areas where coyotes were collected. To date we have necropsied more than 220 coyotes from Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties. Based on our aging estimates thus far, a large fraction of those collected are juveniles less than 1 year old. We will provide a more detailed analysis of the demographic distribution of coyotes collected and a preliminary analysis of coyote diets in urban versus more rural or exurban settings. When completed, our study will provide a more complete picture of the relationship between coyotes and feral cat colonies, which may help aid in the management of both species in the region.

Landscape Use and Movements of Coyotes Across an Urbanization Gradient in Southern California: From Downtown Los Angeles to Suburbia to Rural Agricultural Areas

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Across North America coyotes have shown the ability to adapt to and live in a large range of heavily modified landscapes from the most urbanized parts of large cities to suburban, rural, and agricultural areas. Though it is known that coyotes are highly adaptable, we are only just beginning to understand how they persist in the most heavily urbanized environments such as those in big cities like Chicago and Los Angeles. We present information from GPS- collared coyotes from across a range of landscapes in the Los Angeles area, from downtown to suburban areas to surrounding agricultural areas. Although our sample size is still small, we have seen that coyotes can move about and reproduce even in the most densely urban areas, taking advantage of city streets and residential yards for movement. In areas with lower suburban housing densities, coyotes tend to focus movement in natural habitat remnants with occasional use of developed areas. Finally, in agricultural areas, we see coyotes taking advantage of a combination of natural strips between cultivated areas and the agricultural lands, especially orchards. Coyotes in all of these landscapes have shown the ability to cross roads of a variety of sizes with a relatively low risk of mortality.

10. Urban coyotes

Space Use and Interactions between red foxes and coyotes in Madison, WI

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Red foxes and coyotes have been intensively studied in rural environments, but until recently, have not been rigorously researched in urban areas. In rural landscapes, coyotes spatially exclude red foxes, but their spatial patterns and interactions in urban areas are not as well understood. Effective management of these species requires an understanding of how urbanization affects the ecology of wild urban canids. From January 2015 to December 2016, we captured, radio-collared, and tracked 10 red foxes and 11 coyotes in Madison, WI. Preliminary results suggest that mean coyote home range size is larger than mean red fox home range size, although it appears that there is a great deal of individual variation within species. Within our study area, coyote home ranges were composed of a higher percentage of natural areas when compared to red fox home ranges. Conversely, red fox home ranges were composed of proportionally more developed landscapes when compared to coyote home ranges. Both coyote and red fox activity appeared to be largely nocturnal, but may vary by the individual's location. Our radio location data suggested that red foxes and coyotes spatially separated themselves on the urban landscape. The exact mechanism for this separation remains undetermined, but should be the subject of further research. However, we also have evidence of spatial and temporal overlap, suggesting co-existence between red foxes and coyotes in our study area. Understanding urban canid distribution and space use will better inform wildlife managers in developed areas and promote positive co-existence between these urban canids and humans.

Extreme urban ecology of coyotes in the core of Chicago, Illinois, USA

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Coyotes (*Canis latrans*) are established in virtually every major metropolitan area in North America. In most cases, coyotes represent the largest mammalian predator in cities, and as such has generated considerable interest in their ability to live among people. However, to date most information has come from research conducted in the suburbs or urban fringe of cities. As part of a long-term project in the Chicago area, we expanded our monitoring efforts in 2013 to target coyotes presumably living in the urban core. We used telemetry data to describe space use, activity patterns, and survival, and compared these to patterns we have observed in the suburbs. We also used stable isotope analysis to determine the extent to which urban core coyotes are using subsidies. Mean home range size (km2), as measured with 95% MCP, was greater ($P<0.001$) in the urban core (7.17) than in the suburban matrix (2.16) or natural habitats (3.23). Home ranges were exclusive, indicating coyotes maintained territories in the core. Useable space within territories, as measured using 95% LoCoH, was similar ($P>0.05$) across populations (urban core: 2.34, suburban matrix: 0.93, natural: 2.51). Activity patterns differed between groups, with urban core coyotes exhibiting more exclusive nocturnal activity, with little individual variation in activity during the day but greater variation at night. The level of anthropogenic food in the diet varied considerably among individuals across all groups. Survival rates were similar among groups. Adult coyotes residing in the urban core differ in space use and activity patterns from coyotes in other parts of the urban landscape, but are otherwise similar in diet and survival. Coyotes appear to have successfully colonized throughout the Chicago Metropolitan Area using a variety of strategies.

10. Urban coyotes

Movements and Behavior of Eastern Coyotes in Canada's Largest City

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Once restricted to the central plains of North America, coyotes (*Canis latrans*) are now found throughout the continent, occupying a large variety of habitat types including most urban areas. Once thought of as marginal habitats, recent research suggests that urban areas may offer food and cover on par with, or even superior to, that found in rural and forested areas. Regardless, the presence of coyotes in urban areas is controversial and the cause of much human-wildlife conflict, both perceived and real. Indeed much misinformation exists regarding the density, social behaviour and food habits in urban areas. As such, and as a compliment to a large-scale study of coyote demography in a rural area of southern Ontario, Canada, we radio-tracked 23 coyotes in the Greater Toronto Area (GTA) during 2011 to 2014. Our objectives were to determine baseline demographic parameters for coyotes in the GTA relative to more rural parts of the province, and to determine the relative use of urban versus "natural" habitats by coyotes within the GTA. We used Kernel density estimates to determine home range size and to examine second- and third-order habitat selection. Both rural and urban coyotes were territorial and exhibited family-based pack structures. Annual territory sizes for both rural and urban coyotes were approximately 15 km^2. The composition of habitat within the home ranges of urban coyotes deviated little from what was available, but at finer scales they used green spaces more, and developed areas less, than available. Limited diet data based on scat analysis suggested a largely natural diet for urban coyotes, and use of anthropogenic food tended to increase contact between coyotes and humans. Importantly, despite human densities of approximately 2500/km^2 within their territories, most urban coyotes avoided contact with people and pets at finer scales and thus were not involved in human-wildlife conflict.

11. Ecology of wildlife diseases in urban areas

Raccoon contact networks and rabies transmission dynamics

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Infectious disease transmission often depends on behavior and the contact structure of the host population. New technology has enabled biologists to obtain detailed temporal information on wildlife social contacts. In this study, we investigated the effects of raccoon contact patterns on rabies spread using network modeling. Raccoons can play an important role in the maintenance of rabies and the timing of raccoon rabies outbreaks in the US often exhibits a seasonal peak. We constructed a dynamic system of contact networks based on empirical data from proximity logging collars on a wild suburban raccoon population, and then simulated rabies spread across these networks. Our contact networks incorporated the number and duration of raccoon interactions. By incorporating detailed behavioral data describing the variation in raccoon contact rates into a network modeling approach, we were able to show that suburban raccoon populations are highly susceptible to rabies outbreaks, that the risk of large outbreaks varies seasonally, and that current vaccination target levels may be inadequate to prevent the spread of rabies within these populations.

11. Ecology of wildlife diseases in urban areas

The Vancouver Rat Project: Understanding the relationship between rat ecology and pathogen presence in Vancouver's Downtown Eastside

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Urban rats (*Rattus* spp.) are the source of numerous pathogens responsible for human morbidity and mortality globally. In 2012, the Vancouver Rat Project (VRP) was created to begin to characterize the public health risks posed by rats in an impoverished inner-city neighborhood of Vancouver, Canada. The first phase of the VRP found that Vancouver rats carried the zoonotic pathogen *Leptospira interrogans*. Despite its overall 11% prevalence, *L. interrogans* was unevenly distributed among rat populations with prevalence ranging from 0-66% among city blocks. The fact that colonies with a high prevalence of diseaseco-existed in close proximity to those that were disease-free suggested that colonies may act as self-quarantining units. This led to two hypotheses: 1) that heterogeneous pathogen distributions were driven by rat ecology, specifically, strong site fidelity with minimal movement among adjacent blocks; and 2) that disruptions to stable colonies (e.g., rodent control programs) could alter rat movement patterns and promote disease spread between previously isolated populations. To test these hypotheses, we undertook a seven-month mark-recapture study in 36 city blocks of Vancouver' s Downtown Eastside to both trace rat movement and monitor disease status. Using simulated pest control practices, we tested whether human interventions influence pathogen prevalence. By integrating data on rat ecology and rat-associated zoonoses, we aim to provide a more comprehensive understanding of disease dynamics in urban rats. This information can be used in turn to inform effective approaches to monitor and mitigate the potential impacts of rats in the urban environment.

Host relatedness and urban development shape viral evolution and spread for a fragmentation-sensitive carnivore

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Urban landscapes shift wildlife distribution and behavior, but how they modify pathogen spread remains obscure. Individual host traits and regional landscape structure (natural and anthropogenic) combine to shape pathogen spread, yet demonstrating disease spread over meaningful timescales has been a major limitation to comprehending urban impacts. Here we bring together multiple sources of information (host, landscape & pathogen) and couple analytical approaches (machine learning and Bayesian phylogenography–a "landscape phylodynamics" approach) to understand gene flow and transmission of the fast-evolving feline immunodeficiency virus (FIV) in an urban bobcat (*Lynx rufus*) population; from one of the most fragmented and urban impacted systems in North America. We show that FIV gene flow and spread among bobcats predominates in less urban impacted habitats, and that habitat fragmentation slows both pathogen movement and evolution. FIV transmission events are most likely to occur at greater distances from the urban edge, with transmission events dominated by horizontal transmission, rather than vertical. Together we show that urban landscapes can have a profound impact on contact-dependent pathogen gene flow and spread. Our results reveal how complex host-landscape interactions contribute to pathogen spread in urban systems. This has implications for how spread of emerging pathogens could be controlled following spillover from domestic reservoirs. Our approach is powerful to disentangle multiscale aspects of pathogen gene flow and transmission in host populations.

11. Ecology of wildlife diseases in urban areas

Disentangling the link between supplemental feeding, population density, and prevalence of pathogens with different transmission modes in urban stray cats

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Supplemental feeding in free-roaming animals can alter host-pathogen interactions through mechanisms such as increased host population density and/or aggregated host distribution. In this study, we investigated the potential link between pathogen prevalence and host population density in urban stray cats, which are subject to varying intensities of cat caretaker activity involving supplemental feeding. We selected 6 districts as our study sites in Seoul, Korea, 3 with high and 3 low intensity areas of cat caretaker activity (CCA). Population density of stray cats was estimated in residential areas of each district. Blood samples of stray cats (N=302) were collected through local animal hospitals participating in a trap-neuter-release (TNR) program and tested for 8 different pathogens (feline immunodeficiency virus, feline leukemia virus, feline panleukopenia virus, feline calicivirus, feline herpesvirus-1, Bartonella henselae, hemoplasma, *Toxoplasma gondii*). We analyzed the prevalence of tested pathogens in relation to stray cat population density and intensity of CCA. There was no significant association between stray cat population density and CCA. Neither B. henselae nor feline hemoplasma infection was associated with CCA or host population density. However, prevalence of feline leukemia virus was significantly higher in areas with high CCA (P=0.03), whereas that of feline parvovirus was higher in areas with low CCA (P<0.001). We suggest that supplemental feeding may influence the prevalence of feline leukemia virus and feline parvovirus in urban stray cats by changing cat demographics, foraging patterns, and aggregation behavior. Results from our study may have further implications for other urban-adapted wildlife using anthropogenic food sources.

Infectious diseases in urban coyotes – does land use influence pathogen exposure risk?

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Although urbanization causes habitat loss and fragmentation, some wildlife populations are able to thrive in urban landscapes. However, animals residing in different urban areas will have different interactions with conspecifics and other species, and hence, might vary in their exposure to different types of pathogens. We tested this hypothesis in coyotes (*Canis latrans*) in Chicago from 2000-2012. Serum was obtained from 109 coyotes and tested for antibodies against canine distemper virus (CDV), Leptospira (serogroup Gryppotyphosa), *Toxoplasma gondii* (*T. gondii*), and canine heartworm. Overall prevalence of antibodies against CDV was 31.2% (N=93), 37.6% for Leptospira (N=109), 78.8% for T. gondii (N=109), and 25.6% for canine heartworm (N=90). Land-use related differences were significant only for Leptospira, where antibody prevalence was higher for animals residing in, or in close proximity to, residential areas than those that were further from residential areas. Exposure to CDV was more influenced by season than land-use, in that an individual' s odds of exposure was greater during the breeding and pup-rearing seasons than during the dispersal season. Age was the main factor influencing canine heartworm infection, with infection being significantly lower in juveniles than in pups, yearlings, and adults. Exposure to *T. gondii* was not influenced by any of the factors examined. As preliminary findings, our results suggest that coyote exposure to Leptospira in urban settings varies by habitat type, whereas for CDV and canine heartworm, host traits were more important at predicting exposure.

11. Ecology of wildlife diseases in urban areas

Do zoos play a role in urban wildlife disease transmission networks?

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Most zoos are situated in urban areas and have the potential to play a role in urban wildlife disease transmission. The role could be as disease amplifiers if urban wildlife are subsidized and offered safe haven in zoo facilities, leading to higher wildlife densities, increased transit through facilities, and higher contact rates. Lax biosecurity could also provide opportunities for disease transmission between urban wildlife and collection animals. Alternatively, zoos could dampen wildlife disease transmission if urban wildlife populations are maintained at lower densities, transit through facilities is reduced, and biosecurity practices prevent spillover opportunities. Additional disease dampening could occur by virtue of the intensely concentrated biodiversity of zoo animal collections, which slows transmission due to variable susceptibility of the diverse host species, much like the herd immunity associated with incomplete vaccination of populations. In this presentation, we will explore these issues, present data on urban wildlife within our facilities, provide case examples documenting spillover events between zoo animals and urban wildlife, and discuss management practices that would enable zoos to play a beneficial role for urban wildlife populations.

Salmonella shedding among feral pigs, urban bird species, and waterfowl in Texas

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Salmonella is a pervasive zoonotic pathogen that has been isolated from a number of domestic and wildlife species. Urban wildlife that shed Salmonella can pose a threat to public health. With increasing incursion of urban development into wildlife habitats this threat is increasing. To evaluate potential public health implications, we conducted surveillance studies on urban bird species, feral pigs, and waterfowl in Texas. Among urban birds species such as Great-tailed Grackles (*Quiscalus mexicanus*) and European Starlings (*Sturnus vulgaris*), Salmonella shedding was uncommon, with 1.8% (2/114) of urban birds found to be culture-positive for Salmonella. Similarly, waterfowl migrating through Texas were rarely found to be shedding Salmonella with an estimated prevalence of 0.5% (2/375). Conversely, 43.9% (194/442) of feral pigs in Texas were fecal culture-positive for Salmonella. Among feral pig isolates, the most common serotypes were Montevideo (10.0%), Newport (9.1%), and Give (8.2%), with Newport being a leading serotype among human salmonellosis cases. More research is needed to fully explore the impacts of Salmonella shedding among these and other wildlife species.

11. Ecology of wildlife diseases in urban areas

Seasonal and individual predictors of grey-headed flying fox (*Pteropus poliocephalus*) foraging movements in Adelaide, South Australia and implications for disease

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The distribution of flying foxes in Australia is influenced by the unpredictable availability of their preferred diet, especially eucalypt blossoms. Recently, human activities, including destruction of native habitat and planting of non-native vegetation that provides predictable foraging, have altered the distribution and movements of flying foxes. The consequences of this change are important for both bat and human health, given that bats are reservoirs of Australian bat lyssavirus and Hendra virus, both of which cause fatal disease in humans. In 2010, grey-headed flying foxes (*Pteropus poliocephalus*) established a permanent roost in Adelaide, South Australia, several hundred kilometers outside their previous range. Despite incurring juvenile mortality due to extreme heat events, the population now numbers approximately 7000. As part of a larger study to characterize the health and behavior of the Adelaide flying fox population, we deployed lightweight GPS loggers on bats to track their foraging movements. Loggers recorded a bat' s position every 30 seconds when flying and every 45 minutes when stationary, and also recorded acceleration, speed, and altitude data. Five flying foxes were tracked in winter 2016 and 9 in summer 2017, resulting in 112 nights of movement data. Forty foraging sites were ground-truthed to identify feeding resources. Tracked bats foraged predominantly on urban resources during the summer, potentially increasing the chances for disease transmission to humans and pets. The interaction between sex and body condition affected nightly foraging distance, and should be considered when building models of bat movement and disease spread.

Patterns of Spread of Sarcoptic Mange in an Urban Population of Endangered San Joaquin Kit Foxes: Implications for Mitigation Strategies

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In March 2013, sarcoptic mange was detected in an urban population of endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) in Bakersfield, California. This population is important to conservation and recovery efforts for this species. Over the next two years, the disease rapidly spread throughout much of the city causing numerous mortalities among foxes. To assess and monitor patterns of spread, we conducted systematic city-wide camera surveys in 2015 and 2016. The city was gridded into 1-km^2 cells and camera stations were deployed for 7 nights in 105 cells in 2015 and 111 cells in 2016. Kit foxes were detected in fewer cells in 2016 compared to 2015 (64.8% vs. 46.8%) indicating a possible population decline associated with the mange epidemic. Furthermore, the camera survey data combined with reports from the public and other observations indicated that the spread of mange among kit foxes is strongly associated with fox density. The frequency of cases generally was higher in areas of fox abundance. Importantly, no foxes with mange were detected in the northern portion of the study area where fox detections declined 26.7% between years, but foxes with mange were still being detected in the southern portion where detections had declined by 15.3% between years. Our results indicate that a certain threshold density of foxes may be required to maintain disease transmission, and that once densities fall below this threshold the disease is no longer effectively transmitted.This suggests that foxes in areas of lower density might avoid contracting mange and contribute to population recovery. The results also indicate that strategies to reduce the density of susceptible individuals might be effective in reducing or even terminating the epidemic.

12. Planning, policy, and management for urban wildlife

Using the property tax code to conserve wildlife habitat

Diana M. Foss

Urban Wildlife Program, Texas Parks and Wildlife Department, Houston, TX

In a state that is 97% privately owned, wildlife habitat conservation in urban areas can be challenging.In 1995, Texas voters approved an amendment to the states constitution to allow taxation of open space lands for wildlife management purposes. The tax is based on agricultural productive value rather than market value. This amendment became a powerful tool to allow and encourage landowners and businesses to conserve and actively manage for wildlife on their property.Working with Texas landowners is the only way to assure quality habitat remains for wildlife. In ever expanding urban and suburban areas, this tax valuation is a tool for landowners dealing with increasing property values and the taxes that go with them, giving landowners the incentive to hold land for wildlife, in addition to providing a way to keep lands in the family that might otherwise be targeted by developers. Tax regulations state that the land must be used to generate a sustaining breeding, migrating, or wintering population of indigenous wildlife. Landowners develop and implement management plans whose objectives may target game species, migratory birds, or non-game wildlife such as pollinators or bats. Texas Parks and Wildlife Departments urban wildlife biologists, in partnership with the county tax appraisers, work together to provide workshops for urban landowners to teach best management practices, demonstrate new skills, and give technical information to help complete a wildlife management plan for private properties. Workshops are held throughout the state and focus on topics of particular interest for wildlife management in that region. Site visits and management plan guidance are provided at no cost to landowners. In some cases, property owners are saving millions of dollars in taxes, resulting in thousands of acres of habitat conserved and enhanced for wildlife use.

Protecting Open Space in El Paso, Texas

Lois Balin

Texas Parks and Wildlife Department, El Paso, TX

Urbanization and sprawl threatens to remove and fragment the remaining native Northern Chihuahuan Desert habitat near El Paso, Texas, home to fragile ecosystems and rare and declining wildlife populations. El Paso is overwhelmed by dramatic shifts in demographics and changes in its physical landscape and faces difficult opposition to preservation initiatives. There are just 1.38 acres of park space for every 1,000 persons in El Paso compared with Minneapolis that has 13.3 acres per 1,000 residents. Continued flood damage occurs resulting from the filling, alteration, and development of arroyos, mass grading, and traditional residential development methods. Responding to these and other challenges requires concerted action and collaboration from many stakeholders across political boundaries. Conservation partners in the El Paso region have worked for years to offer a better quality of life through collaboration and partnerships with government, citizen and environmental organizations. These entities and organizations have laid a foundation for smart growth, reducing sprawl and preservation and connection of remaining natural desert habitat. The environmental and conservation community is championing a community effort to conserve public & private lands that have value as natural open space. This presentation will provide specific examples of how natural open space is evaluated, pursued, and acquired using both public and private funds. Details will be provided on successes and failures, and lessons learned in generating community partnerships, engaging residents, creating and leading city-sanctioned advisory boards, safeguarding natural and cultural features, improving wildlife habitat and connectivity, addressing the health of regional watersheds and contributing to the local economy of our communities. This effort includes a science-based approach for land conservation and preservation and is integrated with existing municipal plans such as City Master plans, Plan for El Paso, the El Paso Open Space Plan, and other regional efforts that identify preserving large, connected natural areas.

12. Planning, policy, and management for urban wildlife

The Mayor's Monarch Pledge – Creating Urban Monarch Butterfly Habitat in North America

Patrick Fitzgerald

National Wildlife Federation, Washington, DC

Monarch butterfly populations have plummeted by approximately 90 percent in just the last two decades. These once common, iconic butterflies are declining and future generations may never see a monarch or know of this species epic migration. The threats to the species are the loss of habitat in the United States and Canada through land conversion of habitat for agriculture, removal of native plants and the use of pesticides, and loss of habitat in Mexico from illegal logging around the monarchs' overwintering habitat. The 2016-2017 overwinter population numbers in both California for the western population and Mexico for the eastern population underscore the need to continue conservation measures to reverse this trend. The monarch butterfly is also an indicator species for other pollinators that are also in decline as their habitat is lost. While NWF supports an "all hands on deck" approach to creating healthy habitat for monarch, we have put a special emphasis on working with cities through the Mayors' Monarch Pledge. More than 260 mayors and local government chief executives have committed to more than 1,000 action items to help to help save the monarch butterfly. These actions range from issuing symbolic proclamations to creating demonstration gardens at city hall to changing weed ordinances to allow for the cultivation of milkweed. In 2016, participants in the Mayors'Monarch Pledge created nearly 1,500 acres of new habitat and reached 1.7 million people. This presentation will showcase some of the innovative actions that mayors have taken to create monarch habitat in urban areas across the nation.

Predicting success incorporating conservation subdivisions into land use planning

Christopher E. Moorman, Stephen Allen, M. Nils Peterson, George Hess, and Susan Moore

North Carolina State University, Raleigh, NC

Conservation subdivisions have emerged as a development option for communities wishing to conserve important ecological features and maintain rural character without decreasing housing density. Yet, these alternatives to conventional subdivisions rarely are used. We used logistic regression models to identify variables that predict county level success at adopting an ordinance and having a conservation subdivision built in North Carolina. Important predictors for adopting ordinances were median income, percent urban population, and a negative interaction between the two variables; important predictors for successfully completing a conservation subdivision were the adoption of an ordinance allowing conservation subdivisions and percent of residents with at least a four year college degree. Urban counties and the rural counties with higher median income were most successful adopting ordinances. Urban counties with higher education levels and an ordinance in place were most likely to have a conservation subdivision built within them.In poor rural counties, implementation may be more difficult because of limited resources to develop ordinances; these counties could collaborate with land trusts, other planning departments, or a regional council of governments to help lessen the financial burden associated with rewriting ordinances and implementing new land use practices.

Wildlife Corridors: Policy Efforts in California

Reed Addis

Environmental & Energy Consulting, Sacramento, CA

Reed Addis, Principal at Environmental & Energy Consulting, will discuss efforts to implement state policy on Wildlife Corridors in California. These efforts have been spearheaded by the Wildlife Corridor Working Group, a coalition composed of open space districts, conservancies, land trusts, and other non-profit organizations. This symposium will first touch upon past legislation passed by Assemblymember Marc Levine in the past two years (Assembly Bills 498 and 2087). Following this, current efforts surrounding Wildlife Corridors will be discussed as part of two pieces of legislation. The first is policy language that will provide funding for Wildlife Corridors in the proposed parks bond, Assembly Bill 18 by Assemblymember Eduardo Garcia. The second is a policy bill that will incorporate Wildlife Corridors into state transportation planning, authored by Assemblymember Richard Bloom. Efforts outside the State Legislature include a funding pitch for foundations to assist with financing of Wildlife Corridor projects. Additionally, strategies to encourage multi-agency cooperation between state agencies to establish Wildlife Corridors across California will also be discussed.

12. Planning, policy, and management for urban wildlife

Multi-level Pollinator Management Plan in Municipal Parks

Brett Johnson

Dallas Park and Recreation Department, Dallas, TX

With pollinator conservation efforts being a focus of the conservation community, city parks are an excellent area to implement effective conservation strategies and educate the public. Park department budgets and fluctuate greatly in a short period of time, so a management strategy must be flexible to reflect those changes. This is a case study looking at the establishment of a pollinator conservation plan within the Dallas Park and Recreation Department maintenance practices. The multi-level approach to management practices, partnership development efforts, Citizen Science involvement, and outreach efforts involved in creating a large scale municipal pollinator conservation plan will be discussed.

Successful Outcomes for Diverse Wildlife through Adaptive Management of a Restored Urban River

Lee Marlowe

San Antonio River Authority, San Antonio, TX

Although urban river restoration projects are challenging to implement and maintain, a variety of goals can be achieved simultaneously in these projects including flood conveyance, resiliency of the landscape to disturbances, wildlife habitat, native species biodiversity and public accessibility to nature. The San Antonio River Mission Reach Project is designed to provide beneficial ecological functions along eight miles of the San Antonio River just downstream of the city's urban core, and it is one of the nation's largest urban ecosystem restoration projects. Construction was completed in 2013; however, it will take decades for some of the restoration goals to be achieved. Though it is still young in its development as a riparian woodland ecosystem, monitoring data is already demonstrating success for a diversity of wildlife. This presentation will focus on adaptive management of the restored river habitat in order to provide for spatial and temporal needs of diverse wildlife including species of international significance. The river was a trapezoidal drainage ditch with little ecological functioning before the project, and now it is a biodiverse and thriving river ecosystem benefitting pollinators, Monarchs, birds and other wildlife. The project is a favorite among walkers, bikers, and paddlers including nature enthusiasts and photographers due to its accessibility and beauty. Participants will learn about the site management and monitoring challenges experienced in the project, and the exciting results being measured which prove that urban ecosystem restoration can be successful on many levels.

Predicting Hunting Access Decisions and Hunter Density in an Urbanizing Region

Conner R. Burke[1], M. Nils Peterson[1], Christopher E. Moorman[1], David T. Sawyer[2], and Christopher Serenari[2]

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Urbanization, land parcelization, and shifting landowner demographics in the wildland-urban interface are impacting the persistence of hunting on the landscape, and potentially increasing hunter density on parcels where hunting persists. Rapid urbanization may influence how hunting operates as a wildlife management tool and how harvest reports can be used to create wildlife population indices. We surveyed non-industrial private landowners in North Carolina (n= 1,843), and used model selection to choose the best social and geographic variables for predicting whether a property was hunted and hunter density. Larger properties, properties being used to earn income, and ownership tenure were positively related to whether a property was hunted. Conversely, properties surrounded by higher housing and road densities, and properties whose landowners grew up in urban environments had lower odds of being hunted. Hunter density was negatively related to increasing property size, ownership tenure, and a landowner or family member hunting the property. Hunter density was greatest on small properties (< 2 hectares) in the wildlife-urban interface. Our results indicate that urbanization and rapid property turnover rates may considerably reduce the proportion of huntable land. Despite low incidence of hunting in the wildlife-urban interface, hunter density was greater than in more rural areas. These findings raise questions about interactions between high hunter density and the refuges created by unhunted parcels in suburban landscapes and should be addressed by future research.

Green Infrastructure and Urban Biodiversity: Challenges and Strategies for Monitoring Green Spaces in Malmö, Sweden

Melissa A. Barton

International Institute for Industrial Environmental Economics, Lund University, Lund, Sweden

Ecosystem services offer a useful tool for urban planners to promote inclusion of biodiversity and wildlife habitat. Evolving green infrastructure implementation in Malmö, Sweden, offers insight into the challenge of balancing multiple interests in sustainable development. Malmö, the third largest city in Sweden, has an international reputation for green development based on its post-industrial revitalization. The Augustenborg development, designed primarily to manage flood risks, was one of the first urban regeneration projects based around green infrastructure. Subsequent high-profile developments (*e.g.* Western Harbour; Hyllie) explicitly incorporated biodiversity and wildlife habitat as project goals and, by including ecologists in the planning process and using relevant planning tools, encouraged construction of green space and wildlife habitat features. Malmö's ongoing BiodiverCity program seeks to increase biodiversity, enhance ecosystem services, and improve public health, through six types of experimental plant-based landscaping projects. While green infrastructure expansion forms an integral part of Malmö's new stormwater plan and contributes to the perceived residential attractiveness of new developments, biodiversity outcomes have been mixed and inconsistently monitored. For example, follow-up studies in the early phases of the Western Harbour (Västra Hamnen) redevelopment (2002–2003) found declining plant diversity since construction in 2001 and fewer bird species than in a similar but older development. Evaluation and monitoring of urban biodiversity is crucial to developing urban green spaces that effectively provide both habitat and desired ecosystem services. Adapting existing biodiversity assessment indices or frameworks to local needs and creating partnerships could facilitate a resource-efficient monitoring program. Potential untapped resources include local schools and universities, naturalist groups, community science programs, and existing observation platforms such as eBird or iNaturalist. A better understanding of changing wildlife diversity and distribution in urban green spaces would provide an important tool for Malmö to further align development activities with sustainability goals.

Artificial Burrow Design and Productivity of Western Burrowing Owls in San Diego County

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The western burrowing owl (*Athene cunicularia hypugaea*, BUOW), a California Species of Special Concern, is at risk of local extinction in San Diego County. Successful management of BUOW depends on a thorough understanding of their population dynamics and resource use. Current BUOW management relies on the use of artificial burrows, which require on-going maintenance and may act as ecological traps. Since 2011, we have conducted research focused on several aspects of BUOW breeding season ecology at both natural and artificial burrows. During 2014-2015, we pilot tested the use of iButtons to assess burrow microclimate. The results indicated that natural burrows tend to be better buffers from outside conditions compared to artificial burrows. We hypothesized that the greater variability in temperature and humidity in these artificial burrows might be due to their double entrance configuration. In 2016, we initiated a field experiment to evaluate microclimate in different artificial burrow designs. We also hypothesized that the difference in buffering effects may help explain the lower fledgling numbers we have observed in artificial burrows. We found that artificial burrow design and material (wood, plastic) affect both microclimate and productivity. Here we summarize our findings and provide recommendations for improvements to artificial burrow design.

13. Assessing wildlife connectivity: What can genetics tell us?

Using genetics in connectivity monitoring

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Wildlife populations in urban environments are often highly managed, and understanding and facilitating connectivity among fragmented habitats can improve persistence for many species. Landscape genetics combines genetic data and spatial analyses to quantify impacts of landscape features on movement and gene flow. Over the last decade, major advances in sequencing and analysis tools have facilitated the collection of new genetic data types, increased precision and higher resolution. The nexus between modern genetics and connectivity management can be found in 1) establishing meaningful quantitative thresholds for intervention, 2) developing inexpensive genetic techniques for continuous monitoring, and 3) shifting the focus of population genetic studies from hypothesis testing to parameter estimation. Genetic data collection can be combined with other field research goals, such as determining reproduction and survival rates, and understanding habitat associations, to provide important insight for conservation and management.

A single migrant enhances the genetic diversity of an inbred puma population

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Migration is essential for maintaining genetic diversity among populations, and pumas (*Puma concolor*) provide an excellent model for studying the genetic impacts of migrants on populations isolated by increasing human development. In densely-populated southern California, USA, puma populations on the east and west side of interstate highway 15 (I-15) have become fragmented into a small inbred population on the west side (Santa Ana Mountains) and a relatively larger, more diverse population on the east side (Eastern Peninsular Range). Our genetic analyses of 146 pumas in this region showed that 7 pumas crossed I-15 over the last 15 years, including four males from west to east, and three males from east to west. However, only a single migrant (named M86) produced offspring and contributed to gene flow across the I-15 barrier. Prior to the M86 migration, the Santa Ana population exhibited inbreeding and had significantly lower genetic diversity than the Eastern Peninsular Range population. After M86 emigrated, he sired 11 offspring with Santa Ana females, decreasing inbreeding measures and raising heterozygosity to levels similar to pumas in the Eastern Peninsular Range. The emigration of M86 also introduced new alleles into the Santa Ana population, although allelic richness still remained significantly lower than the Eastern Peninsular population. Our results clearly show the benefit of a single migrant to the genetics of a small, isolated population. However, ongoing development and habitat loss on both sides of I-15 will increasingly strengthen the barrier to successful migration. Further monitoring, and potential human intervention, including minimizing development effects on connectivity, adding improving freeway crossing structures, or animal translocation, may be needed to ensure adequate gene flow and long-term persistence of the Santa Ana puma population.

13. Assessing wildlife connectivity: What can genetics tell us?

Using genetics to assess landscape connectivity in urbanized coastal southern California for an indicator species: Bobcat

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Habitat fragmentation can reduce functional landscape connectivity, or how the landscape facilitates or impedes the movement of organisms among habitat patches. However, measuring the degree of connectivity across the landscape over time and space remains a challenge. In urbanized landscapes, bobcats (Lynx rufus) have been a particularly useful model species for understanding and measuring the effects of habitat fragmentation in a complex network of urbanization and protected spaces because they are still widely distributed and sensitive to urbanization. Previous studies focused on bobcats in urban landscapes have shown that urbanization negatively affects bobcat dispersal, limiting gene flow and, in some cases, causing extirpation in isolated patches. However, to date, these studies have largely been disparate, considering only small-scale connectivity within specific study areas. In this study, we compiled genetic data from Los Angeles, Orange, and San Diego counties and analyzed landscape connectivity on this larger, regional scale. We used microsatellites to assess whether genetic distance or degree of isolation is a predictor of genetic variation in fragmented regions of southern California. More specifically, genetic variation within and among study sites was used to determine whether landscape characteristics, such as varying levels of roads and urbanization, influence bobcat movement and gene flow across a gradient of urbanization in coastal southern California. This study enhances our understanding of the limitations to bobcat dispersal and migration at the local and regional level in an urbanized environment, but more
importantly, presents a powerful approach to measuring connectivity across the regional landscape, providing data to support landscape-level conservation planning and management.

Spatial Scale and Structure of Genetic Relationships between Mojave Desert Tortoises (*Gopherus agassizii*) in Solar Development Zones

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The Mojave Desert tortoise (Gopherus agassizii) is federally and state listed as threatened, largely because of decreases in population density and range. Utility-scale solar developments on public lands have recently increased tortoise habitat fragmentation and may result in a reduction of genetic connectivity. In 2015 we surveyed three 1-km2 plots in Ivanpah Valley, an area that recently experienced rapid solar development. Blood samples (n=73) were collected from all tortoises found and genotyped at 21 previously identified microsatellite loci. A landscape genetics approach was used to detect historic tortoise connectivity and to spatially evaluate genetic relationships. We used genetic differentiation and parentage analysis to look for population structure and evaluate migration rates across the study area. Genetic differentiation in Ivanpah Valley is low (FST = 0.024), corresponding with rangewide estimates (FST = 0.009 to 0.023), indicating potential for recent geographic barriers, like large utility-scale solar facilities, to have negative genetic consequences on the species. Spatial analysis shows a pattern of Isolation-By-Distance for first order genetic relationships, but a wider distribution for second order relationships. Our results indicate that desert tortoises in Ivanpah Valley were connected across the historic landscape and provide a baseline for research on future genetic disruption in reduced and fragmented habitat.

13. Assessing wildlife connectivity: What can genetics tell us?

A century of landscape disturbance and urbanization of the San Francisco Bay region affects genetic connectivity and diversity of the California Ridgway's Rail (*Rallus obsoletus obsoletus*)

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Fragmentation and loss of natural habitat have important consequences for wild populations and can negatively affect long-term viability and resilience to environmental change. Salt marsh obligate species, such as those that occupy the San Francisco Bay Estuary in western North America, occupy already impaired habitats as result of human development and modifications and are highly susceptible to increased habitat loss and fragmentation due to global climate change. We examined the genetic variation of the California Ridgway's rail (*Rallus obsoletus obsoletus*), a state and federally endangered species that occurs within the fragmented salt marsh of the San Francisco Bay Estuary. We genotyped 107 rails across 11 microsatellite loci and a single mitochondrial gene to estimate genetic diversity and population structure among seven salt marsh fragments and assessed demographic connectivity by inferring patterns of gene flow and migration rates. We found pronounced genetic structuring among four geographically separate genetic clusters across the San Francisco Bay. Gene flow analyses supported a stepping stone model of gene flow from south-to-north. However, contemporary gene flow among the regional embayments was low. Genetic diversity among occupied salt marshes and genetic clusters were not significantly different. However, we detected low effective population sizes and significantly high relatedness among individuals within salt marshes. Preserving genetic diversity and connectivity throughout the San Francisco Bay may require attention to salt marsh restoration in the Central Bay where habitat is both most limited and most fragmented. Incorporating periodic genetic sampling into the management regime may help evaluate population trends and guide long-term management priorities.

A Tale of Two Songbirds: Contrasting Effects of Habitat Fragmentation Between Coastal Sage Scrub Obligates

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Coastal sage scrub habitat in coastal southern California persists today mostly in small patches fragmented by urban area. In order to understand the consequences of this fragmentation on connectivity, we used a large library of DNA microsatellites and a thorough sampling regime to analyze population structure and genetic diversity in two songbirds, the Cactus Wren and the California Gnatcatcher. We found no indication that habitat fragmentation was limiting for connectivity among California Gnatcatcher aggregations; however, strong genetic differentiation was evident among Cactus Wren groups throughout the study area. This genetic structure was evident in multiple Bayesian clustering methods, a conservative exact test for differentiation among groups, and genetic distance indices. Patterns of genetic structure in the Cactus Wren mirrored those of habitat availability and fragmentation by urbanization. Using a habitat model developed for the species, we detected positive correlations between genetic diversity indices and local habitat availability. We also found a correlation between fire histories of individual populations of Cactus Wrens and genetic bottlenecks, indicating that the species has been impacted by pervasive fires in coastal southern California. The contrasting patterns between the two species has important consequences for management decisions regarding coastal sage scrub habitat. Namely, while the California Gnatcatcher has long served as an umbrella species for the protection of coastal sage scrub habitat, its persistence may be a poor indicator for the fate of other species with more limited connectivity. Further, future persistence of Cactus Wren populations in the study area may depend on major management actions, such as habitat restoration to improve local population sizes and connectivity or even egg-switching to bolster local genetic diversity levels.

13. Assessing wildlife connectivity: What can genetics tell us?

Population structure in mule deer (*Odocoileus hemionus*) across major highways in Southern California

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Urbanization is a substantial force shaping the genetic and demographic structure of natural populations. As urban areas expand, so too do transportation corridors facilitating human movement, such as highways. Further, underpasses and overpasses are generally not designed explicitly to encourage wildlife use. It is therefore not surprising that highways have been shown to pose a major barrier to gene flow in a variety of species. Research using camera traps in our study area have shown that mule deer have highly specific requirements for utilizing such structures and are known to be sensitive to roadways. Hence, deer may be more highly impacted by the isolating effects of highways. In contrast, deer are highly mobile and less restricted by territoriality than other species such as carnivores, and so may have more opportunities for reproduction, and thus gene flow, upon successfully traversing freeway barriers. To determine if highways form barriers to gene flow in mule deer, we used non-invasive genetic sampling to assess how populations are structured with respect to five major highways in Southern California. We collected samples from two major regions surrounding Los Angeles and Orange Counties. We genotyped 255 unique individuals across 15 microsatellite loci and a single sex marker using DNA extracted from scat. We showed that genetic distance corresponded to the magnitude of the barrier as measured by average daily traffic volumes and surrounding urban matrix. We also find variation between historic and current migration rates across highways, and we used a simulation to assess how temporal and spatial features of individual highways may explain mule deer population substructure. Our results indicate that both highways and urban development can contribute to genetic structuring and reduced gene flow in mule deer.

Genetic mark recapture of southern mule deer reveals limited seasonal movement and genetic structure across San Diego County

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The southern mule deer is a mobile but non-migratory large mammal found in southern California and is a covered species in the San Diego Multi-Species Conservation Plan. Since 2005, we have had the opportunity to monitor genetic connectivity for this subspecies in urban San Diego County by genotyping fresh deer scat. To date we have successfully genotyped nearly 367 scat samples representing 223 individual deer. We find that Southern mule deer in this region have less overall genetic diversity than subspecies elsewhere in the state and are relatively sedentary over many years. Females that are found in close proximity are more closely related than co-occurring males. We discuss some of the challenges to defining management units based on traditional population genetic methods, and propose complementary analyses to infer the permeability of the landscape to gene flow for this species.

13. Assessing wildlife connectivity: What can genetics tell us?

Connectivity among populations of the endangered San Diego fairy shrimp in a military landscape

Natalie Goddard[1], Andrew J. Bohonak[1], Marie A. Simovich[2], Ketan V. Patel[1], Charles Black[3] and Nicholas S. Graige[1]

[1]San Diego State University; [2]University of San Diego; [3]MCAS Miramar

The San Diego fairy shrimp (*Branchinecta sandiegonensis*) is listed as federally endangered as a result of large-scale urbanization and subsequent vernal pool habitat loss. When new pools are created for mitigation or disturbed pools are restored, sediment from existing pools may be used for inoculation. The success of these projects can depend on whether source material is taken from a gene pool that is differentially adapted from the destination. Previous studies have suggested that there are at least two relatively differentiated gene pools of San Diego fairy shrimp within San Diego County. A putative contact zone between these gene pools occurs primarily within Marine Corps Air Station at Miramar (MCAS Miramar). Using the mitochondrial gene COI in conjunction with seven microsatellite loci, we have delineated the gene pool boundary with greater precision than was previously known. We have also tested for additional population structure within each of these regional gene pools, based on a variety of pool-specific and landscape features. A greater understanding of the processes underlying genetic population structure in endangered species such as the San Diego fairy shrimp can lead to more effective management and conservation decisions.

Is genetic admixture in the San Diego fairy shrimp (*Branchinecta sandiegonensis*) associated with vernal pool disturbance?

Ketan Patel, Andrew J. Bohonak, Marie A. Simovich, Natalie S. Goddard and Nicholas Graige

San Diego State University; University of San Diego

Because only 3-7% of intact coastal vernal pool habitat remains today, conservation efforts prioritize the maintenance of existing pools and the genetic integrity of its inhabitants. Recently, Simovich et al (2013) investigated potential admixture between the endemic San Diego fairy shrimp (*Branchinecta sandiegonensis*) and a widespread generalist: the versatile fairy shrimp (*B. lindahli*). Their published hybrid index is based on interspecies differences in dorsolateral spinal patterns found on mature females. We have developed a complementary genomic hybrid index that uses 20 alternatively fixed SNPs between the two pure species to detect hybrid individuals and quantify their degree of admixture. We have genotyped over 1000 individuals (adult females, immature females and males) across 50 localities in southern California, making this the largest investigation of genetic admixture in vernal pool shrimp to date. Highly disturbed basins are correlated with the presence of hybrids, while undisturbed vernal pool complexes only contain homozygotes for *B. sandiegonensis* or *B. lindahli*. Beyond identifying admixed populations, the combined morphology-genomics approach will facilitate future monitoring efforts, and inform conservation planning for the San Diego fairy shrimp.

14. Special Session

Urban Wildlife: Working Together for a Wilder Future

Join us for this half-day session to explore how challenges of open space and wildlife conservation are being met in urban regions across the US. Through short talks, panel sessions, and audience discussion, we will explore how city planners, policy makers, land managers, and scientists work together to conserve and manage urban open space and wildlife.

Online resources for this session available at http://www.urban-wildlife.org/specialsession.html

Urban Wildlife Context (1:00PM - 2:00PM).
Urban open space and wildlife conservation depends on the landscape, legislative, and legal context of the region. Setting the stage for the program, representatives from six urban regions - Boulder, Chicago, Los Angeles, Raleigh (Wake County), Tucson (Pima County), & San Diego - will introduce the specific contexts in which they work and discuss how place-based factors - including the amount and distribution of natural areas, public, and private land, the number of jurisdictions involved, and the use of regulatory and voluntary approaches - affect urban wildlife conservation.

Living with Wildlife (2:00PM - 3:00PM).
Conservation in urban regions increases interactions both positive and negative - among people and wildlife. Urban wildlife conservation means balancing conservation and recreation, providing outreach and education about wildlife, mitigating roadway impacts, and addressing other conflicts between people and wildlife. What actions have cities taken in land management, planning, and science to accentuate the positive and reduce the negative interactions?

Semi-Structured Break (3:00PM - 3:30PM).
Gather in the courtyard for refreshments and conversation. Panelists will be grouped by theme - Living with Wildlife, Creating Landscape Linkages, and Working Together.

Creating Landscape Linkage (3:30PM - 4:30PM)
Wildlife movement around and through urban regions is essential to support urban wildlife and their natural systems. However, wildlife movement depends on a urban landscape that includes connected ecological networks. Representatives from several regions will share their experiences supporting and promoting landscape connectivity.

Working Together for a Wilder Future (4:30PM - 5:30PM)
Conserving and managing open spaces and viable wildlife populations in urban regions requires navigating many challenges, including competing priorities for limited funding and differing views about open space, wildlife, and where, whether, and how conservation should be carried out. In this session, panelists and participants will share their experiences on how partnerships among city planners, policy makers, land managers, and scientists have helped to meet these challenges.

15. Ecology, behavior, and conservation of urban mammals

Coyote and freeroaming cat detections are positively correlated in an urban wildland in Los Angeles

Travis Longcore[1], Benjamin Banet[1], Miguel Ordeñana[2], Greg Pauly[2], and James P. Dines[2]

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The Baldwin Hills are a two square mile island of native and exotic scrublands, grasslands, and forested habitats isolated from other open spaces by the urbanized Los Angeles Basin. We investigated the distribution of mesocarnivores through a network of remotely triggered cameras in this remnant open space. In this paper, we report on two aspects of the results of that effort: the distribution and number of freeroaming cats and the relationship between detection rate of coyotes and that of freeroaming cats, which we compare with previous studies showing a negative relationship between coyote presence and freeroaming cat activity. We deployed 14 trail cameras over more than two years and captured 1,791 images of freeroaming cats and 103 images of coyotes. We then classified each cat photograph by individual using characteristics of its coat and other unique features. The image capture rates for coyotes and freeroaming cats were positively correlated (Pearson's $r=0.75$, $p<0.002$). We identified 59 individual cats in photographs, which were photographed 1 to 333 times each and with a duration between first and last observations ranging up to 840 days. The number of different cats identified per location ranged from 1 to 11. Coyotes have recently (re)colonized the Baldwin Hills; they had been absent in the early 2000s. Several feeding stations for feral cats appear to drive rates of observation of both freeroaming cats and coyotes, which are presumably attracted to both the cat food and prey items subsidized by the food source. The Baldwin Hills support an interesting complement of native mammals, including gray fox, and are a site of extirpation of sensitive scrub-dwelling bird species such as Cactus Wren. Effective management to promote and restore native wildlife should include removal of food subsidies for feral cats.

Cottontail rabbits (*Sylvilagus* spp.) as a potential urban food resource for bobcats (*Lynx rufus*) in a southern California landscape

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Urban fragmented landscapes act as a mosaic of habitats each with distinctresources. Mammals are known vary in their sensitivity to urban fragmentation where more tolerant species persist by exploiting urban resources. In urban fragmented Thousand Oaks, California cottontail rabbits (*Sylvilagus* spp.) occur in urban and natural habitats however there is little known about their densities in urban areas and if urban rabbit populations are a source subsidy for more urban sensitive carnivores, specifically bobcats (*Lynx rufus*). Bobcats are known to occur in urban habitats but whether bobcats exploit resources from urban environments is not well known but has been cited as an explanation for their presence in urban areas. We collected data on the distribution and abundance of cottontail rabbits using visual line transects and fecal pellets counts to determine the abundance of rabbits across the landscape over one year. We then modeled the relative probability of occurrence of 7 female bobcats using resource selection functions (RSFs) to test if bobcats occur more frequently in habitats with high rabbit densities. Rabbit density was highest in urban areas during summer months however urban rabbit density varied the most compared to other habitat types. Urban edges also had relatively high rabbit densities during summer and fall months which then dropped in winter months. Rabbits exhibited intermediate densities and varied the least in natural habitat patches. During active periods bobcats decreased their use of natural habitats and increased their use of urban edges and habitats, both urban and natural, close to urban edges. Our study demonstrates that cottontail rabbit densities can be inflated in urban habitats and gives reasoning to the claim that bobcats enter urbanized areas to exploit rabbits as an urban food resource.

Habitat associations of an ecosystem engineer: returning the California ground squirrel to its rightful place

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The California ground squirrel (*Otospermophilus beecheyi*) is generally undervalued despite serving as an integral component of grassland ecosystems. Ample evidence of significant abiotic ecosystem engineering effects by squirrels indicates that population reductions have cascading effects on other species. Implementation of ground squirrel management has been initiated to support species covered by regional land management plans, such as western burrowing owl. While the theory and practices behind habitat association studies are well established, in this case it filled a critical need to identify priority management options in degraded grasslands expected to change further under shifts in climate. We conducted surveys for California ground squirrels throughout San Diego County grasslands and examined associations of habitat covariates with squirrel distribution and relative abundance. The primary objectives were to 1) improve understanding of the habitat variables associated with squirrel presence and 2) develop a predictive model for squirrel habitat suitability at local scale. A model averaging approach showed the most predictive models included significant main effects for sand and vegetation cover. A 10% increase in vegetation was associated with 1.3 fold lower odds of squirrel presence, while a 10% increase in sand was associated with 1.7 times higher odds of squirrel presence. Mixed effect models indicated a strong site effect, and produced accurate predictive models for squirrel presence at the survey sites. Comparison of the predictive accuracy of soil texture data at two scales showed fine-scale field sampling has greater predictive strength. Because soil type is a logistically non-malleable factor for wildlife managers, it is important to categorize management sites by soil type to identify the potential for promoting fossorial species on the landscape. With the prospect of shifting landscape ecotones due to climate change, it is as important to understand the basic habitat requirements of keystone species as for rare species.

Comparison of Seasonal Movements Between Localized Populations of Urban and Rural White-tailed Deer (*Odocoileus virginianus*) in Southern Indiana

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Ball State University, Muncie, IN

In recent years, the movement patterns of urbanized populations of White-tailed deer (*Odocoileus virginianus*) (hereafter WTD) have become a major area of interest to wildlife professionals. Although a handful of studies have focused on the movement characteristics of either the urban or rural populations of this species, few if any have ever compared these parameters between both populations on a localized scale. By understanding the extent of seasonal movement between adjacent populations of urban and rural WTD within the same general area, wildlife biologists and other stakeholders gain valuable information in which to basis management decisions for the benefit of both the herd and the impacted citizens. This study was conducted in three counties in southern Indiana: Morgan, Monroe, and Brown. The city of Bloomington, Indiana has a healthy population of urban deer. WTD were captured using dropnets, suspended net guns, Clover traps, or free-darted from a distance. All WTD were then equipped with GPS or VHF collars and monitored using satellite or radio telemetry to obtain location data. From January-July 2015-16 a total of 86 WTD was captured consisting of 45 urban individuals and 41 rural individuals. We used detectability modeling to determine the probability of observing a seasonal excursion event given a WTD underwent excursion at some point during the year. Results suggest that urban WTD were slightly less likely to perform excursions than their rural counterparts. Similarly, average excursion distances from seasonal home ranges were shorter for urban WTD (mean = 2.56 km; SE ± 0.68) than rural WTD (mean = 2.71 km; SE ± 0.56).

San Clemente Island Fox: An Ambassador for Coexistence

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The island fox (*Urocyon littoralis*) has history of association with humans dating back to pre-columbian times. This relationship continues to this day, with the San Clemente island fox (*U. l. clementae*) being a focal species for conservation by the U.S. Navy. The San Clemente fox population generally occurs at higher densities in association with human development and occupancy, and research reveals that most adult mortality come from anthropogenic sources. The Navy funds and oversees a comprehensive fox conservation and research program including: roadside mowing and vehicle speed reduction efforts, public outreach, veterinary and pathology services, a disease sentinel-monitoring program, serological analyses, and demographic research. The Navy uses findings from this research to inform management activities for San Clemente's fox population. The Navy also administers best management practices for all new development to avoid common urban-interface wildlife issues.Under this successful program, the SCI fox population has grown from approximately 430 individuals in 2007 to approximately >1,000 individuals in 2014. Known-fate survival estimates based on 108 radio collared foxes monitored from 2014–2015 yielded an annual survival rate of 89% for adult foxes. The Navy's research-based management and ongoing monitoring program have combined to help ensure the survival of San Clemente's island fox population.

To live and die in LA: Conservation Of The Western Gray Squirrel In Griffith Park Through Genetic Analysis

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While there is an increasing trend of population reductions of the Western gray squirrel (WGS) in California, up until now, no genetic research had been done to assess the extent of this loss. Griffith Park (GP) is a large urban park in Los Angeles that is home to a small population of WGSs that is presumably isolated from the larger contiguous population in the Santa Monica Mountains (SMMs) and other local populations near GP. The park and surrounding areas have factors responsible for local population contractions such as habitat fragmentation, potential competition with the Eastern fox squirrel (*Sciurus niger*), and other anthropogenic disturbances which pose a risk for local extinction. In order to assess the WGS population for conservation purposes, genetic diversity was estimated for the population in Griffith Park. Non-invasive sampling was conducted at three sample sites in GP to collect hair using hairtubes from which DNA was extracted. Twelve microsatellite loci and the mtDNA control region were used to characterize the genetic diversity of WGS in GP. Metrics included gene flow, population structure, bottleneck events, allelic richness, and relatedness. Diversity estimates for WGSs in GP were compared to diversity estimates for two other WGS populations, SMM and Bonelli Park (BP), to determine the level of relative genetic variation within GP. Microsatellite results indicated low levels of genetic variation within GP, high relatedness, and elevated genetic differentiation among subpopulations. Nuclear DNA and mtDNA analyses suggested that GP is isolated and genetically divergent from both SMM and BP. Mitochondrial DNA indicated that the potential source population for WGSs in GP came from local mountains to the east instead of the SMMs to the west. Overall, results revealed that WGSs in GP are vulnerable to extinction and confirmed the need for its management.

Behavioural observations of eastern grey kangaroos in a suburban landscape

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Eastern grey kangaroos (*Macropus giganteus*) are found in the eastern states of mainland Australia. They inhabit woodlands, sclerophyll forests, shrublands and heathlands, and often occur in urban areas. It is crucial to understand the behaviour of this species to effectively manage their increased distribution and abundance in urban areas. Camera data has not been previously used to examine eastern grey kangaroo behaviour. Previous studies on eastern grey kangaroo behaviour have been conducted either on foot or using collars that record postures. Camera traps create fewer disturbances to animals therefore eliminating any effect of human presence on the animal's behaviour, and provides more detailed insight than activity data from radio collars. The behaviour of eastern grey kangaroos was observed using infra-red motion detection cameras which were setup up in 48 locations across two sites in NSW Australia. One site was located on the Hawkesbury campus of Western Sydney University in Richmond NSW, and consisted of a 308ha site that is fragmented by surrounding development, and located in a semi-rural suburban area containing built infrastructure such as roads and buildings. The second site was located in the Wolgan Valley Resort and consisted of a 1619 ha site with very few limitations on connectivity to the surrounding landscape, located in a conservation area surrounded by National Parks bushland. Cameras were set to record 60 second videos when triggered. Research was conducted between September 2014 and August 2016. This study reports on the behavioural patterns of eastern grey kangaroos living in a fragmented habitat that is surrounded by urban development. Behavioural patterns of eastern grey kangaroos including activity patterns and social interactions were compared. Results from the study will be discussed.

Aggression and boldness in Merriam's kangaroo rat: an urban-tolerant species?

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Urban development can fragment and degrade habitat, and such habitat alterations can have profound impacts on wildlife behavior. In urban areas, individuals may occur closer to each other and experience high levels of disturbance, which may favor increased aggression and boldness in urban-dwelling wildlife. We investigated the influence of urbanization on aggression and boldness and the relationships between these traits in Merriam's kangaroo rat (*Dipodomys merriami*). We predicted that Merriam's kangaroo rats living in urban areas would be more aggressive and bolder than Merriam's kangaroo rats in wildland areas, that the 2 traits would be positively associated, and that the association would be stronger in urban areas. We livetrapped Merriam's kangaroo rats at 4 urban and 4 wildland sites in and around Las Cruces, New Mexico, USA, and assessed aggression using a mirror-image stimulation test and boldness using a predator scent exposure. We found no difference between urban and wildland Merriam's kangaroo rats in either aggression or boldness. We found a positive statistical relationship between aggression and boldness, but this relationship was not affected by urban versus wildland habitat. These results indicate that Merriam's kangaroo rats may be tolerant of urbanization, if habitat patches within urban areas are similar to wildland habitats.

Avoidance Behavior and Diel Shifts by Mammals in Urban Reserves

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Human activities affect wildlife in a variety of ways, both direct (*e.g*., hunting, supplemental feeding, culling) and indirect (*e.g*., displacement from habitat loss, competition with invasives, avoidance of anthropogenic features). Even ostensiblybenign activities such as hiking or horseback riding in established parks may affect spatial and temporal activity of wildlife species. Characterization and quantification of effects is essential if parks and other protected areas are to balance the dual needs to nurture an appreciation of wildlands or satisfy a need to encounternature (*i.e*., biophilia hypotheses) and to ensure that wild animals can survive and reproduce. We explored how human presence affects wildlife presence in a spatially extensive system of camera traps established in various protected areas in coastal southern California. We developed a conceptual framework based on joint probabilities of occurrence to create a novel statistical approach to assess whether observed probabilities of co-occurrence differed from expected probabilities of co-occurrence. We found that wildlife presence was significantly lower than expected if probabilities of human and wildlife occurrence were independent, a pattern that held across sites, seven species of large and medium-sized mammals, and five types of human disturbance. We further assessed to what extent avoidance was temporal by means of circular statistics. We found that certain species shifted their activity patterns to become more nocturnal, shifts that could alter trophic dynamics via changes in predator and prey encounter rates. Lastly, by means of time-series analysis we determined that mammal activity has a distinctly seasonal pattern, with peaks in spring or summer, whereas human activity has a increasing linear trend. Increasing human pressure coupled with strong evidence for avoidance and temporal shifts highlights the need to forge management plans that both facilitate human–nature interaction but eschew detriment to wildlife populations.

An investigation of learning, problem-solving, and behavioral flexibility in raccoons (Procyon lotor) and striped skunks (*Mephitis mephitis*)

Lauren Stanton and Sarah Benson-Amram

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Despite the challenges associated with anthropogenic disturbance, many species show a remarkable ability to thrive in urban environments. Understanding what makes some animals better able to persist in urban environments is essential for biodiversity conservation and mitigation of human-wildlife conflict. The cognitive buffer hypothesis (CBH) posits that the cognitive abilities associated with large relative brain size allow animals to modify their behavior in adaptive ways when confronted with challenges in their environment, such as urbanization. However, empirical evidence of the CBH is limited, and we do not have a firm understanding of the cognitive abilities of urban wildlife. To better understand the link between cognition and urbanization, we have begun testing of the CBH by assessing the cognitive abilities of the widespread and highly adaptive raccoon (*Procyon lotor*) using a multi-compartment puzzle box. First, we presented 13 raccoons with a single-solution puzzle box, where four individuals opened at least one compartment and three demonstrated repeated success. Next, we presented 12 raccoons with a multi-solution puzzle box that contained four possible solutions. Seven participants found at least one solution, and three of those raccoons solved all four solutions. We also observed approximately 50 instances of wild striped skunks (*Mephitis mephitis*) interacting with the puzzle boxes, however no skunks were ever able to open a compartment. Thus, in accordance with the CBH, it appears that raccoons are more innovative and behaviorally flexible than skunks, which have a smaller relative brain size compared to raccoons. We are now expanding our efforts by developing automated puzzle feeders that will assess cognitive abilities across species and environmental gradients. This new and innovative methodology will allow us to further explore the relationship between cognition and urbanization, and advance current technologies used to study wildlife.

16. Dysfunctional urban biodiversity planning: Take home messages for (and from) ecologists and planners/designers

Building for Birds: A New Online Design Tool to Assess the Impact of Development

Mark Hostetler and Jan Archer

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Information regarding the impacts of different urban designs on avian species is largely out of reach for most decision-makers because it is accessible only through many different journal articles and technical reports. In order to evaluate the impacts of different development designs on birds, landscape architects and urban planners need a tool that reflects current research and is in a format that can be used in typical planning venues. We present a new online, evaluation tool called Building for Birds (http://wec.ifas.ufl.edu/buildingforbirds/web/tools.html). The goal of the Building for Birds tool is to provide decision makers with a way to evaluate different development scenarios and how they affect habitat for species of forest birds during breeding/wintering and migration seasons. From a systematic review of empirical studies in U.S. and Canada, we have created lists of species for three avian habitat categories. Avian habitat categories are 1) forest fragments used as breeding/wintering habitat, 2) forest fragments used as stopover habitat during migration, and 3) tree canopy within residential areas used as breeding/wintering and/or stopover habitat. Inputs for the tool are the amount of conserved forest fragments and tree canopy in built areas; points are allocated per acre of forest and tree canopy conserved, and these points are different depending if a bird is using the site as breeding/wintering habitat and/or as stopover habitat during migration. Outputs are bird habitat scores and a list of potential birds that could be found in each of three aforementioned habitat categories. We found a surprising number of birds that use fragmented landscapes, including interior forest specialists that use relatively small forest fragments and tree canopy in built areas as stopover habitat. Overall, the tool allows city planners and landscape architects to assess impacts of different development and city designs, and such understanding will enable decision makers to incorporate bird-friendly designs into the planning process.

Governing for diversity: What is the potential for fostering positive feedback among biodiversity, place attachment, and stewardship in urban green spaces?:

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Vital urban green spaces represent an important component of a sustainable urban future. They function both as the major repositories of biodiversity in metropolitan regions and as the primary locus for an array of human-environment interactions. Yet, basic information, such as the magnitude of ecosystem services delivered by urban green infrastructure, remains disputed, and social processes connecting environmental conditions to human well-being, such as place attachment (people' s psychological connection to place) in an urban context are virtually unexplored. Thus, an important remaining frontier is identifying feedbacks from altered biotic communities in green spaces to human well-being and decision-making. For example, are people more motivated to engage in urban greening activities when they encounter greater species diversity or regionally distinctive species in their neighborhood green spaces? In addition, who gets to participate in decisions about the management of green spaces? And how does this affect people' s access and attachment to these places? We posit that (a) there is a relationship between the governance arrangements of urban green spaces and peoples' attachment to them, which translates to (b) changes in stewardship, which affects the ecosystem functioning and ecosystem services, and ultimately creates (c) feedbacks into governance systems and place attachment. In a case study in forested parks in Springfield, Massachusetts, we illustrate potential for both positive and negative feedbacks. Greater access to forested areas is associated with greater place attachment; greater place attachment is associated with higher bird species richness and fewer invasive plants along trails. However, negative feedbacks may arise from perceived lack of access (*e.g.* implementation of fees) and a sense from users that parks are 'overgrown'. Together, this and other cases studies suggest that far from parks being 'loved to death', increased access may foster place attachment, stewardship and ultimately improved environmental conditions.

16. Dysfunctional urban biodiversity planning: Take home messages for (and from) ecologists and planners/designers

Building a Better Mousetrap: Proactively Managing Wildlife Damage in an Urbanized Landscape

David Drake

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Alteration of the land to meet the needs of an urbanized population has been the single greatest force shaping the American landscape in recent decades. With nearly 85% of Americans currently living in the built environment, most human-wildlife interactions occur in urban areas, and many of these interactions are negative in nature. It is estimated that urban residents spend $8 billion annually to manage wildlife damage in and around residential and commercial buildings. Wildlife species inhabiting urban areas are typically found in higher densities relative to their non-urban counterparts, resulting in overabundant populations that can cause property and natural resource damage, and human health issues. With some planning foresight, many of the common wildlife damage issues can be reduced or eliminated. For example, choice of building materials and architectural design can mitigate wildlife damage to residential and commercial buildings. On a larger scale, how urban planning and development occurs has direct consequences relative to types and numbers of wildlife that are present, as well as frequency of human-wildlife interactions. In addition to more ecologically-minded urban planning, developing and building, education is a critical component. Zoning officials, developers and builders need increased information and knowledge about wildlife' s use of the built landscape. In this presentation, I'll cover the breadth and magnitude of wildlife damage in urban landscapes, and discuss how proactive management at different scales may be able to mitigate wildlife damage. Finally, different types of audiences and education campaigns will be discussed to improve knowledge about managing wildlife damage throughout the urban planning, development, and post-construction phases.

Let's Build Shared Vocabularies, Based on Values

David Maddox

The Nature of Cities, New York, NY

Most ecologists, designers, planners would like to collaborate with each other in productive ways. Transdisciplinarity and co-production are trendy 3 buzzwords of the day. But what do they mean? Truely working together is more elusive. Why? A significant reason is that groups of professionals, and the clients they serve, don' t have a shared vocabulary. They may share words, but the words don' t have the same meaning. For example, ecologists and landscape architects both talk about "ecological design". But both words means something different to an LA or ecologist. At the surface this is an issue of communication, but at the core it is a problem of values. There are fundamental beliefs that each hold about key words such as "ecology" and "design" that the other doesn' t share, and perhaps isn't even aware of. It is similar for any pair of professions: design, ecology, sociology, community building, planning, wildlife, development. Another reason is that two groups may be distrustful of the others' way of knowing, its methodology. Ecologists can be frustrated by the lack of "evidence" in design. For a designer data is not the only "evidence". This problem is also seen when we want to create spaces that communities want. We apply our own values to the design, but never bother to ask the people what they want. The vocabularies are not shared. The real answer to this conundrum is to truly work together. This does not mean contributing to the same project at different phases. Rather, it means working together in real time to develop the vocabulary and underlying values of a project. Often this requires us to engage with and convince the clients that this is a good method, because they may have yet another vocabulary. But such a vocabulary development is key to true transdisciplinarity.

16. Dysfunctional urban biodiversity planning: Take home messages for (and from) ecologists and planners/designers

How Small is Too Small? The role of protected area size and surrounding land use in conserving unique forest bird assemblages within an urban landscape

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The creation of protected areas provides potential solutions to the loss of biodiversity posed by land development. However, due to limited money and land availability, protected area designation has shifted away from governments towards local and non-governmental organizations. This shift in responsibility for protected area establishment is a global trend picking up steam over the past two decades, but New Jersey adopted this mode of protected area acquisition in the 1960s. Within the urbanizing forests of the New Jersey highlands there are now over 4,400 protected areas, with most areas being 500ha or smaller. Given their size and number, these protected forests are embedded in a very complex matrix of human-modified land uses (*e.g.*, residential development, industrial use, and agriculture). In order to assess the value of these protected areas in terms of their contribution to regional bird diversity, we documented how the size (ha) and surrounding land use influenced protected area bird diversity. In particular, we wanted to know if there was a threshold protected area size below which the bird community became indistinguishable from the community utilizing surrounding human-modified habitats. We suggest that any protected area below this threshold is not functioning to preserve unique forest bird communities, but is instead a simple extension of surrounding land use types. Our results show that such size thresholds exist in New Jersey, and that where this threshold lies varies according to surrounding land use types. For planners our results suggest that, if the goal of designating land as 'protected' relates to biodiversity preservation, there are clear size and locational constraints that will prohibit goal achievement. For ecologists, our results emphasize that protected area size interplays strongly with landscape context, thus shaping the ecological value of the growing number for small locally-managed protected areas.

How Ecologists Can Make a Difference from a Planner's Perspective

Steve Hofstetter

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If you are an ecologist and want to see urban wildlife strategies and other conservation measures taking place in your community, then you need to SHOW UP. City and community planning is a slow and often painful process. If you do not submit comments and show up at public hearings, then you cannot complain about the lack of sustainable activities happening in your community. As the saying goes, "If you do not buy a ticket, you can' t win the lottery."I am going to talk about what you need to do to make a difference in the planning of your community. It is human nature to wait until the last hearing to voice your concerns. As a planner, I have seen this happen repeatedly, and by then it is usually too late to change the outcome. I will briefly describe the nuts-and-bolts of local government planning so that we can expose the barriers to implementing conservation efforts and urban wildlife opportunities. My examples come from lessons learned from Alachua County, a generally rural area interspersed with small to mid-sized cities in north central Florida. Specifically, I am going to target the challenges of dealing with privately owned properties, where there are multiple goals and expectations for both the property owner and the community. I will focus on the experiences learned from adopting a comprehensive plan and land development code with strong conservation elements and I will focus on what worked (and did not work) when ecologists, elected officials, citizen activists, and planners teamed up to develop a conservation vision for our community. My goal is to leave the audience with strategies on what ecologists can do to positively influence the planning process, goals, and policies of a community to improve urban wildlife opportunities.

16. Dysfunctional urban biodiversity planning: Take home messages for (and from) ecologists and planners/designers

You Want a Corridor for What?" Lessons from the Intersection of Urban Ecology, Planning, and Design

Travis Longcore

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Urban wildlife research has yielded many insights and knowledge about the ways in which wildlife species persist and disappear from cities. Notwithstanding this significant progress, planners and landscape architects have only begun to grasp the lessons of this research and ecologists often reinforce concepts for the public that are only half measures. Drawing for 20 years of applied urban conservation research and practice, I highlight a few lessons for the field. Conservation strategies need specific species targets to be effective or even measured. Conservation strategies have to scale to the target organisms. Small patches can be perfectly effective, especially if the natural habitat type is patchy, or the target species is small. For many species the habitat is the urban matrix and enhancing it has actual ecological value. If you restore habitats, species follow, but not all of them. Disturbance, of the right kind, is not only useful, but in many instances essential for the long-term viability of early succession species in urban fragments, even if it means disturbing native vegetation. Cities have a tendency to homogenize the environment that must be resisted to maximize biodiversity, which means protecting and designing for hydrodiversity, photodiversity, and topodiversity. All urban nature requires management that requires planning and resources. In this presentation, I will give short examples of these principles to highlight where designers, planners, and wildlife researchers can collaborate to create more wildlife and biodiversity friendly cities.

What have we learned from collaborative ecological landscape design in urban area in Japan?

Keitaro Ito and Tomomi Sudo

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What is urban ecology and biodiversity? We have been designing landscape even in urban areas, based on vernacular design (ecology, regional culture and so on) for the past decade. The aim of these projects is to create an area for preserving biodiversity, children's play and ecological education that can simultaneously form part of an ecological network in an urban area. In these past ten years, I have been designing to have interdisciplinary research and proposing to install the layer for children's play and biodiversity in an urban area. We would like to discuss the problem and future issues through our projects, exotic species, children' s play and managing urban nature from a landscape designer' s point of view. Multi-Functional Landscape Planning analysis have been used for the projects. MFLP approach will be effective to evaluate for the planning of a project such as urban park. According to this method, the space is divided into a number of layers (layers of vegetation, water, playground and ecological learning), which overlap each other. Thus, during the creation of a multi-functional play area, children are able to engage in "various activities" as its different layers are added on top of each other. In addition, they will learn something new about its ecology when they are playing there. Landscape designers should consider "landscape" as an "Omniscape" in which it is much more important to think of landscape design embracing not only the joy of seeing, but stimulating a more holistic way of using body and senses for learning. Landscape designers and architects need support of biologist/ecologist for ecological design and planning. Consequently, we would like to continue these projects as long as possible and raise children with the experience of nature in their childhood, which will create more diverse cultures and biodiversity together even in urban areas.

16. Dysfunctional urban biodiversity planning: Take home messages for (and from) ecologists and planners/designers

Integrating “Ways of Knowing” and “Ways of Doing” to Develop an Ecological Planning Approach to Urban Wildlife

Sarah Jack Hinners

Ecological Planning Center, University of Utah, Department of City and Metropolitan Planning, Utah

Increasingly, urban ecology and urban planning find themselves working in overlapping spaces and issues, but significant obstacles to productive interaction exist. In direct contrast to ecology as an objective science, planning is value-oriented, and what' s more, exclusively focused on values associated with human wellbeing. A second fundamental difference is that between “ways of knowing” and “ways of doing”; ecologists seek merely to increase our understanding of the world as it is, whereas planners seek actively to create and shape the world. To give the phrase “ecological planning”true meaning, we would need to find ways to integrate the work processes of these two fields in order to co-produce both knowledge and physical built environments. I will discuss the comparative process models of ecology and planning, and look for specific barriers and opportunities to develop such a relationship with regard to urban wildlife in particular.

Crossing the Science/Design Divide

Jason King (Associate ASLA, CLARB, LEED AP)

Mithun/Pier 56, Seattle, Washington

It is well known that ecologists and Landscape Architects are key actors in preservation and enhancement of biodiversity in cities, and have unique opportunities to inform one another in the creation of environments for urban wildlife. Our challenge to achieve these shared goals is to better align the key strengths of each discipline - focusing the scientific analysis to achieve accessible and applied solutions, while integrating design synthesis that achieves cultural goals and rigorous, measurable ecological outcomes. There are many good examples of collaborations that result in positive urban habitat for flora, fauna, and people, often emerging from interdisciplinary efforts. However integrated design/science firms and the inclusion of scientists on development teams is still relatively rare. The disciplinary boundaries continue to perpetuate a disconnect of academia and practice, resulting in scientific research that is inaccessible, offering little to designers, and design solutions that privilege aesthetics goals and offer shallow, ‘boutique’ ecologies lacking function. This presentation will outline some of the successes and failures above, and offer a number positive strategies to be employed by 6 ecologists and designers to increase collaboration and success. We will discover the core principles of Landscape Urbanism and Ecological Urbanism which offer theoretical opportunities for hybrid practices, while offering new modes of interdisciplinary project work. Next, we will address the ideas of Novel Ecosystems and Resilience, aided by a better understanding of urban science, in better informing flexible design solutions. Finally, we will discuss ecologically informed design strategies and certification such as SITES, Salmon Safe, and Living Building Challenge and how they can shape and expand the potential of biodiverse projects. Together, these strategies can reduce the impacts of urbanization on biodiversity and enhance urban wildlife through better collaboration.

17. Coastal systems and wildlife in urban areas

Thermal effluent and impacts on thermoregulation of aquatic reptiles: response to rapid changes in water temperature

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Industrial power plants that utilize once-through cooling (OTC) systems discharge thermal effluent into freshwater and/or marine environments and the heated discharge often significantly affects the local habitat, creating an unnatural thermal ecology. Aquatic reptiles that inhabit these altered environments have demonstrated physiological and behavioral changes as a result of inhabiting areas with temperatures that exceed natural thermal regimes. Reptiles that depend on narrow environmental thermal conditions to maintain internal body temperatures may be particularly susceptible to the impacts of thermal effluent. Research on the physiological and behavioral effects of changing water temperatures on mobile aquatic species remains limited, in part because of the logistical challenges associated with studying animal responses in natural systems. As OTC power facilities become outdated and replaced with cleaner, more efficient technologies, rapid shifts in water temperature will occur, providing insight into the thermal response of aquatic reptiles. In light of other indirect anthropogenic activities that may also lead to rapid shifts in water temperature, e.g. climate change, the need to monitor animal responses to thermal shifts will intensify. Using available literature and a case study from San Diego Bay, this review synthesizes the evidence of the effects of thermal effluent on aquatic coastal species to understand how these species respond to relatively rapid shifts in water temperature.

Sharing the beach: evidence of a white shark nursery off southern California beaches

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Over the last 10 years, there has been an increase in young-of-the-year (YOY) white sharks (< 1.75 m TL) caught and observed along the southern California (CA) coastline, with many animals observed <100 m of the shoreline. We have tagged 32 YOY and juvenile white sharks with coded acoustic transmitters to track their long-term (multiple year) movements and site fidelity to nearshore locations throughout southern CA. While tracking data have indicated that juvenile white sharks typically leave southern CA waters and migrate south during the winter, in 2013 (n=1), 2014 (n=5) and 2015 (n=1) individuals were detected in nearshore southern CA waters throughout the year, likely due to El Niño conditions. Tagged individuals were found to use some of southern CA's most popular beaches. In 2015 most detections came from two 7 km stretches of beach in southern Santa Monica Bay (SMB) (29.5% of Total Detections) and North Orange County (64.3% of Total Detections). Five individuals tagged in SMB displayed high site fidelity to that area being detected for 88 to 163 days, with one up to 113 consecutive days. Similar patterns were observed along North Orange County with tagged individuals detected up to 135 days at that location, despite a high degree of human activity in the area. Three tagged individuals moved between these two beach hotspots. In addition, four tagged individuals have been detected using Los Angeles/Long Beach Harbors, one of the largest commercial ports in the world. These data suggest that YOYare spending large amounts of time in shallow coastal beach habitats and show high fidelity to small areas, which is indicative of nursery habitat use.Juvenile white sharks are spending considerable time in heavily urbanized areas (*e.g.*, popular beaches and commercial ports) where their likelihood of interacting with humans is high.

17. Coastal systems and wildlife in urban areas

Implications of shifting home ranges of green turtles in a highly urbanized bay

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Along the coast of southern California, San Diego Bay is one of two year-round foraging grounds for a population of approximately 60 East Pacific green turtles (*Chelonia mydas*) that has ongoing new recruits entering the area. The bay is an urbanized environment with anthropogenic inputs from industrial, military, and recreational activities. Between 1960 and 2010, a power plant operated in south San Diego Bay and discharged warm-water into an effluent channel. To better understand fine-scale movement patterns and potential home range shifts of green turtles in this area, we tracked 18 green turtles (7 pre-closure, 2007-09; 11 post-closure, 2011-14) using Argos-linked GPS satellite transmitters. Turtles were tracked from 15 to 104 days (mean tracking duration = 50 days). Home ranges were constructed from 1052 pre-closure and 1222 post-closure filtered GPS and Argos-derived locations. These points were used in adehabitatHR for kernel density home range estimations that used least-squares cross validation for bandwidth selection. These estimates showed that green turtle home ranges increased in area by 105% (1.08 km2) and 33.3% (1.99 km^2) for 50% and 95% Utilization Distributions (UD), respectively, since the power plant closure. In recent years, monitoring efforts have indicated an increase in stranded green turtles in the bay. Given home range changes and habitat use patterns found in these movement data, our research efforts can help provide insights about increased prevalence of mortality in the bay. Future conservation efforts must continue to focus on an understanding of the distribution and movements of green turtles in the bay so that effective conservation and protective measures can be developed for this species.

A regional approach to assess sea-level rise impacts to North America Pacific coast tidal wetland habitats

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Climate change effects on coastal salt marsh habitats will include rising sea levels and changes in the frequency and severity of storms. Sea levels are projected to increase up to 1.6m by 2100 along the Pacific coast and storms are expected to increase in frequency and magnitude, threatening the persistence of tidal marsh habitats and obligate wildlife at this land-sea interface. Land managers are tasked with conserving these areas and the wildlife species dependent upon them. However, climate adaptation plans are challenging for managers to develop, primarily because detailed baseline data of current conditions, relationships among linked habitats, and models that project future habitat conditions at a local scale are often lacking. Detailed ground data for elevation, plant community composition, tidal inundation, and accretion were collected in 18 estuaries in California, Oregon and Washington. We used radioisotope dating from sediment cores to calibrate a Wetland Accretion Response Model for Ecosystem Resilience (WARMER) that projects wetland elevations under sea-level rise scenarios through 2110. Model results showed that sea-level rise resilience varied across the Pacific coast estuaries and was driven by local processes and the extent of anthropogenic modification of the estuary. Tidal wetlands located within highly urbanized estuaries such as California's San Francisco and San Diego Bays had the lowest accretion rates and did not keep pace with sea-level rise and were submerged by 2080 threatening expansive areas of endangered species habitat. Wetland sites in less modified estuaries had higher accretion rates and persisted under higher rates of sea-level rise to 2110. High and mid marsh habitats were lost earlier in the century with low marsh habitats persisting longer. Our results show that this type of site specific information can help inform endangered species management and restoration efforts along the coast.

Bayou City: Using Houston's Waterways to Connect People and Wildlife.

Kelly Norrid

Texas Parks and Wildlife, Urban Wildlife Technical Guidance Program, Houston, TX

Nestled in a meandering network of urban bayous and streams, governmental and private organizations in the nation's third largest city are planning an ambitious connectivity project in an urban area. By utilizing the creeks and bayous, governmental and NGO's are planning a series of recreational trails and wildlife corridors that will crisscross the city to connect people and wildlife to the multitude of green spaces fragmented throughout the region. According to the Harris County Flood Control District, Harris County, Texas has about 2,500 miles of natural and man-made waterways meandering throughout the county. Of these waterways, less than 6% are concrete lined drainage ditches where most are either natural or grass lined waterways. This unique landscape affords the third largest county in the United States the unique opportunity to use these corridors for recreational and wildlife use. Cooperation between private and governmental agencies are making this a reality. This presentation will highlight the efforts of these governmental and private organizations to create a county-wide network of recreational trails to connect the green spaces within the region. The design and development of the trail system is not only being looked at from the recreational point of view, but also being designed to be used by wildlife. By creating wildlife friendly corridors throughout the county it is hoped that this will help lessen the negative impacts with the human/wildlife conflicts within urban Harris County.

Impacts of urbanization on the ecological condition of sandy beach ecosystems

Nicholas K. Schooler, Jenifer E. Dugan, and David M. Hubbard

University of California, Santa Barbara

Urbanization fragments and degrades habitat and impacts biodiversity and ecosystem function. With the accelerated population growth and increasing urbanization of coastlines worldwide, quantitative information on the responses of coastal biodiversity to urbanization is urgently needed. For sandy beach ecosystems in densely populated southern California, our multi-decadal comparisons of intertidal macroinvertebrate communities indicated that biodiversity of urban beaches was consistently >50% lower (<15 species) than for natural beaches (>40 species) since the 1970s. To quantify the influence of urbanization on intertidal biodiversity we compared macroinvertebrate communities of 16 southern California beaches (9 natural, 7 urban) in recent surveys (2009-2015). Species richness, abundance, and biomass of intertidal communities were significantly lower on urban than natural beaches and community assemblages differed significantly. While a small subset of apparently resilient species persisted on both urban and natural beaches, the diversity of upper beach macroalgal wrack-associated taxa was greatly reduced on urban beaches. We identified six species and five Families as indicator taxa, all associated with the upper beach wrack community except for two Families. We documented extensive loss of endemic beach taxa on urban beaches, particularly upper beach biota. The extirpation of two peracarid isopods from >55% of historically occupied beaches in southern California indicated high vulnerability of upper beach species with low dispersal to urbanization. These losses of upper intertidal biodiversity have important implications for ecosystem functions. Upper intertidal consumer diversity, particularly talitrid amphipods, strongly affects the processing of wrack subsidies via shredding and consumption. This, in turn, can reduce the rate of nutrient cycling through beaches, affecting a vital ecosystem function that can support nearshore primary producers, like kelps and surfgrasses. Our results to date suggest that urbanization profoundly impacts diversity of sandy beach ecosystems.

Modeling Waterbird Habitat Associations to Inform Tidal Marsh Restoration in an Urbanized Estuary

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The San Francisco Bay (SFB), like many other urbanized estuaries, is a critical wintering and stop-over area for migratory waterbirds. More than a million wintering waterbirds annually rely on a mosaic of natural and managed habitats in SFB, including former salt ponds. The South Bay Salt Pond Restoration Project plans restore 50 to 90% of a 6,100 hectare former salt production pond complex to tidal marsh, while maintaining the rest as foraging and roosting areas for migratory birds. Since 2002, we have evaluated migratory waterbird use of pre- and post-restoration salt ponds in south SFB. Our approach has been to use monthly surveys, applied studies and modeling to evaluate avian response to this changing habitat. Trend analyses indicate that overall waterbird numbers have nearly doubled across the complex from 2003-2014. Dabbling ducks increased significantly during initial phases of the project, while diving ducks, small and medium shorebird abundances declined initially, but rebounded in recent years. We modeled relationships between abundances of multiple species and habitat characteristics at both landscape and micro-scales. Modeling results suggest that the importance of different habitat characteristics varies among waterbird guilds. For example, foraging diving duck abundances were higher in deep, un-breached ponds, located close to the edge of SFB, while foraging small shorebirds predominated in shallow, breached ponds containing islands. Our research highlights important habitat characteristics both within and across ponds, and provides a unique opportunity to guide future management and restoration decisions for multiple species across large landscapes in SFB and other urbanized estuaries.

Comparing persistent organic pollutants and trace metals in green sea turtles inhabiting two urbanized habitats in southern California

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Persistent organic pollutants (POP) and trace metal contamination (TMC) are associated with deleterious health effects in organisms, particularly inhabiting urbanized coastal regions. Two foraging aggregations of east Pacific green sea turtles (*Chelonia mydas*) inhabiting Long Beach (LB) and San Diego (SD) exhibit year-round presence and strong site fidelity. Characterizing contaminant loads of these two turtle aggregations is important towards understanding the possible negative effects of anthropogenic contaminants. To calibrate POP and TMC methodology, turtles that have stranded in the LB and SD areas had their liver, heart, kidney, muscle, and fat tissue extracted and analyzed for POP and TMC using gas chromatography mass spectrometry (GCMS) and inductively coupled plasma mass spectrometry (ICPMS). Preliminary results on stranded animals indicate undetectable (MDL 1 – 0.5 ng/g) to moderate amounts of POP contamination (123.00 – 9.51 ng/g wet mass total POPs necropsy tissue) in both aggregations. Comparatively, preliminary results indicate possible differences in TMC between stranded animals in SD and LB; however, sample size is still limited. The stranded individual from LB had high cadmium contamination (221.49 µg/g wet mass) in kidney tissue compared with another stranded individual from SD (53.26 µg/g wet mass). While samples from stranded animals were used to calibrate methodology, 38 live green sea turtles from the LB (n = 14 turtles) and SD (n = 23 turtles), were captured, measured and had blood and scute samples obtained for contaminant comparison. POP contamination will be determined using blood plasma with a modified soxhlet extraction using GCMS. TMC will be determined using red blood cells and scute samples with acid digestion and ICPMS. Pending analysis, blood and scute samples will be used to corroborate the preliminary results found in stranded samples; particularly, to assess POP contamination loads, and to assess whether there are differences in TMC between resident animals in both locations.

17. Coastal systems and wildlife in urban areas

Malibu Lagoon: Results of Restoration, 2005-present

Daniel S. Cooper

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The restoration of 12-hectare Malibu Lagoon on the coast north of Los Angeles was begun in 2012 after more than 20 years of planning and controversy. I report on the avifaunal changes at the site based on more than 10 years of quarterly bird monitoring, and on records of thousands of visits by birders submitted to eBird. Designed to enhance water circulation and to increase saltmarsh habitat at a small coastal lagoon, the restoration involved dredging roughly half the site, re-contouring channels, and salvaging and planting thousands of native plants. Five years later, results are difficult to interpret due to the lack of initial restoration goals for birds or other wildlife species. At least one natural community, freshwater marsh, was temporarily lost but is recovering, albeit in a reduced state. Most of the variation in bird numbers is due to three super-abundant species, California Gull (*Larus californicus*), Brown Pelican (*Pelecanus occidentalis*), and Elegant Tern (*Thalasseus elegans*), all of which were present prior to the restoration. While no saltmarsh-obligate bird species have colonized the site, species typical of herbaceous coastal vegetation are present in small numbers, including Western Meadowlark (*Sturnella neglecta*), which now over-winters. I use Malibu Lagoon as a case study to discuss the challenges of interpreting restoration success at small urban sites, particularly those with disagreement about historical conditions and future goals.

18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes

From ensemble species distribution models to ensemble corridors: A case study from San Diego County

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The gold standard for modeling connectivity is the use of movement data from GPS telemetry collars. However, this data is often expensive, difficult to obtain and highly invasive for the target species. Additionally, for species in rapidly developing areas, there is often not time to conduct a full telemetry study to inform conservation and management decisions. The use of occurrence data sets for connectivity modeling is attractive as they are often readily available for many areas, however occurrence data has some limitations, mainly, (1) that the data are often collected opportunistically, making defining the study area and background points difficult, (2) that the data reflect static point detections, not movement, and (3) that no single 'best' model to analyze this type of data has been identified, making model choice difficult. We use occurrence data for a suite of different taxa – California mouse (*Peromyscus californicus*), wrentit (*Chamaea fasciata*) and Califonia mule deer (*Odocoileus hemionus californicus*) – across San Diego County to estimate species occurrence, resistance, and connectivity in an ensemble modeling framework.Specifically, we use a variety of recommended models (Generalized Linear Models, Generalized Additive Models, Multiple Adaptive Regression Splines, Maximum Entropy Models, Random Forest Models, and Boosted Regression Trees) to create ensemble models of species occurrence. We translate this occurrence into resistance for the State Route 67 study area using linear and power transformations and model Factorial Least-Cost Paths and Resistant Kernels to identify road crossing locations and corridors. In the face of model uncertainty and differences among modeloutputs, this framework allows us to 'hedge our bets' and integrate the best performing models into a single product that identifies the most probable areas of connectivity for multiple species in a rapidly developing area of the county.

18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes

Quantifying the structural and functional connectivity of habitat patches for Chicago area mesocarnivores

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Understanding the effective isolation of individual habitat patches is essential to effectively manage populations in fragmented landscapes. For classic fragmented habitats (*e.g.*, oceanic islands), patch isolation can be easily calculated. However, urban landscapes are permeable, and species may persist within the urban matrix, or move through it with resistance. Thus, the effective isolation between habitat patches is likely not only a function of Euclidean distance, but also type of habitat that separates them. To better understand habitat connectivity in urban environments, we studied the dynamics of Chicago's mesocarnivore guild. We deployed camera traps at ~100 sites throughout Chicago in the spring, summer, fall, and winter, from 2011 to 2013. We used a Bayesian dynamic multi-species occupancy model to determine how nearest neighbor distance, patch area, percent canopy cover, and housing density influenced each species ability to colonize and persist in habitat patches throughout Chicago. While nearly every species was less likely to colonize patches that were more isolated from their nearest neighbor, the type of habitat between patches either impeded (areas with higher housing density) or facilitated (areas with higher canopy cover) colonization rates. Patch area had no effect on colonization or persistence rates, which likely indicates that habitat patches are poorly defined by the physical boundaries set by land managers. By studying the community dynamics of mesocarnivores throughout Chicagoland, our study elucidates factors that can aid the conservation of urban biodiversity

Connectivity planning under climate change for urban wildlife in southern California

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Successful management of California wildlife is complicated by climate change, particularly in areas where ongoing urbanization constrains wildlife movement. Increasing landscape connectivity is frequently recommended as a strategy to facilitate wildlife responding to these stressors. However, while stressors are changing through time, existing connectivity plans typically do not account for species'population dynamics or the changing climate and land use circumstances that will determine success or failure of recommended corridors. Using novel modeling techniques that combine habitat suitability predictions and dynamic meta-population models, we quantify the effectiveness of existing connectivity plans to increase persistence of wildlife responding to global change. By comparing population models with and without identified corridors, we evaluate the population resilience benefit conferred by a particular corridor under changing climate and land use. Future models will explore the benefit of connectivity under global change for a wider variety of focal species, incorporating a suite of different life histories and dispersal abilities.

18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes

An assessment of connectivity between areas of high wildlife diversity and between habitats that are likely vulnerable to climate change in Washington, DC

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Beyond the proximate threats of urban development and land use, climate change will affect nearly every aspect of natural resource management, land use planning, and future development for the District of Columbia (District or DC). Such effects will likely be changes in forest cover, sea level rise, and massive changes in infrastructure needs. The District's Climate Change Adaptation Plan and Sustainable DC Plan call for actions that provide access to green spaces; preserve natural systems, wildlife, and landscapes; and ensure the resilience of natural and human systems. As such, understanding where such green space and land conservation would most greatly benefit wildlife species of greatest conservation need (SGCN) and increase the connectivity of natural land cover in the District is vital. Therefore, using a geographical information system, we created a basic dissimilarity model, which included land cover percentages, road density, and spatial landscape metrics, using a kernel density map of SGCN locations. That dissimilarity map was used as a resistant map in corridor identification analysis. This corridor identification was then overlaid with the current public green space in the District of Columbia to identify other potential natural spaces as well as the path of least resistance to existing protected areas. We concentrated the site-specific analysis on areas that had been determined potentially vulnerable to climate change in the Climate Change Vulnerability Assessment of the 2015 State Wildlife Action Plan. Not surprisingly, eastern and western sections of the District show the most promise for additional North-South corridor establishment and small blocks of land that could be considered for long-term protection.

Building science-management partnerships to develop actionable connectivity plans in urban southern California

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In southern California, the California Natural Community Conservation Planning (NCCP) program has developed ecological networks in response to widespread habitat fragmentation. These networks are designed to protect biodiversity by conserving core habitats. Connectivity is essential if these networks are to support long-term conservation goals. However, the design and implementation of linkage plans for connectivity within and between plan areas has lagged, as have quantitative assessments of functional connectivity. Furthermore, connectivity planning that has taken place has not considered landscape dynamics such as disturbances, land-use changes, or how species' ranges are likely to shift in response to climate change. By leveraging and expanding upon the relationships from existing science-management partnerships, we are working with land managers and conservation planners to develop tools that meet local management goals and organizational missions while guiding regional coordination to create robust connectivity plans. Through this work, we are building on prior connectivity assessment projects (*e.g.*, California Essential Habitats Connectivity Project and South Coast Missing Linkages) projects by applying innovative analytical tools to available data sources for a suite of species to develop site-specific plans to preserve landscape at both the local and regional levels. We will discuss how regional coordination of connectivity planning is essential for providing an actionable framework to consider opportunities for adaptation under future climate and land use conditions. In doing so, we will describe how our approach facilitates implementation actions and supports practical, proactive management and planning for connectivity through direct stakeholder engagement and collaboration. We will summarize how the linkage maps developed through our work will be used to develop decision support guides to aid agencies in the identification and prioritization of land acquisition targets, land management goals, and habitat enhancement projects to protect and improve landscape linkages.

18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes

Design and Implementation of a Wildlife Corridor in Metropolitan Tucson

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I describe the design and implementation of a wildlife corridor connecting the Santa Catalina Mountains to the Tortolita Mountains near Tucson, Arizona. The original corridor design included 3 broad strands. One of the 3 strands – 1 km wide and 8 km long and including 2 highway crossing structures – is being conserved by actions of the Arizona State Land Department, Pima County, the town of Oro Valley, Arizona Game and Fish Department, the Coalition for Sonoran Desert Protection, and the regional and state transportation agencies. I illustrate how science helped lead to a good compromise, but I emphasize the crucial importance of bureaucrats and other non-scientists. In my experience, scientists contribute little to conservation by traditional modes of (one-way) "outreach and communication" to decision-makers. Effective contribution to conservation occurs when scientists engage with managers, policy makers, and other stakeholders over the long term to identify specific decisions to be informed by science, jointly define the research questions, methods, and outputs, and co-produce scientific inferences and strategies for the appropriate use of science.

Preserving and increasing connectivity for wildlife in Los Angeles: long-term interagency planning, and efforts to build a wildlife overpass across 10 lanes of busy urban freeway

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Roads have significant impacts on the survival and movement of wildlife, but these impacts can be particularly severe in urban landscapes where the densities of roads and the volumes of traffic are highest. Santa Monica Mountains National Recreation Area (SMMNRA) is a national park in the Los Angeles area, so at SMMNRA our wildlife studies and management efforts are focused on understanding and mitigating the effects of urbanization, including roads. We have worked closely with many partner agencies, particularly the California Department of Transportation (CalTrans), to better understand the effects of roads on wildlife, particularly the effects of larger freeways and highways. Although we have evaluated mortality as well, many of these roads are large enough and have a high enough traffic volume that many species rarely attempt to cross them, so that the major effects are as barriers. We have found that larger roads in and around the park are major barriers to movement, and often even to gene flow, for a variety of species including mountain lions, bobcats, and coyotes, but also smaller vertebrates such as lizards and birds. After landscape scale studies between 2002 and 2006 determined that connecting the Santa Monica Mountains to other natural areas was one of the most endangered and critical linkages in the region, we put together a regional group called the Linkage Implementation Alliance (LIA) to coordinate efforts to maintain and improve this linkage. Finally, we have worked with multiple partners for more than two decades on an effort to plan and build the a wildlife crossing for 101, the freeway that effectively isolates the Santa Monica Mountains. We are currently pursuing a vegetated wildlife overpass over 101, a larger, busier, and more urban freeway than has ever been bridged before.

18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes

Metro Habitat Connectivity Toolkit: Bringing Connectivity to an Actionable Scale

Leslie Bliss-Ketchum

Samara Group LLC, Portland, OR

The Urban Biodiversity Inventory Framework (UBIF) and associated online tool (at http://ubif.us) is a flexible yet robust framework designed to provide cities with appropriate guidance in order to successfully record, analyze and assess biodiversity information in urban areas. Cities are increasingly being recognized as important locations for local biodiversity, endangered species and/or for providing key stopover sites for migratory species. As human populations grow and available habitat areas shrink, the need to track and maintain urban biodiversity becomes increasingly important. By providing a way to accurately and consistently assess biodiversity resources and track changes over time the UBIF can assist cities in making appropriate management decisions to protect this critical asset. The UBIF assists cities by providing a record of biodiversity information to support proactive efforts to maintain and enhance biodiversity as well as the ability to identify the need for response when species are declining. By applying the UBIF methodology, cities can monitor the response to actions designed to enhance biodiversity, such as restoration activities. The UBIF structure also allows cities to record changes in biodiversity for a specific species, taxa group, or for multiple taxa in a specific habitat of interest. This flexibility provides information at different levels of organization and can also be used to generate a "report card" or summary score, aiding in communicating of biological information to diverse audiences. Phase 1 of the UBIF project was initiated by five partner cities (St. Louis MO, San Francisco CA, Portland OR, Pittsburgh PA and Philadelphia PA), active in the Urban Sustainability Directors Network (USDN) with funding from the USDN and Summit Foundation. These cities selected Samara Group LLC to develop the frameworkin recognition of the need to accurately assess biodiversity in urban areas.

Hahamongna to Tujunga Wildlife Corridor: Planning for Urban Wildlife

Barbara Goto[1], John Howell[1], Nancy L.C. Steele[1], John Wros[2], Johanna Turner, and Denis Callet

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In June 2016, Bear Red #2 (tagged by CDFW) was spotted lounging in a backyard pool in a suburban community below the Angeles National Forest. Two days later, she was spotted in a densely populated urban area in the San Rafael Hills; five days after that she was seen in the Verdugo Mountains. How did she navigate the heavily developed areas to get there? A routine check of our trail cameras in Cottonwood Canyon (Pasadena, CA) showed the bear wallowing in the stream before heading uphill, past the mouth of the spring, on her way over to the San Rafael Hills and, ultimately, where she was spotted in Glendale. The bear's adventures validate the canyon's use as a thoroughfare between large blocks of natural open space in the urban Los Angeles County. Our presentation focuses on our work to support establishment of a wildlife corridor that will provide connectivity for urban wildlife isolated in urban natural landscape blocks in the San Fernando and San Gabriel Valleys. Our species of concern is the mountain lion, in particular P41, which has been documented as being isolated in the Verdugo Mountains, and P-22, which is marooned in Griffith Park. Through a science and policy-based approach, we inform our conservation strategy with an improved understanding of wildlife conservation requirements, including barriers and solutions. Our goal is to create a 20-mile wildlife corridor to connect these lions to both each other and back to the Angeles National Forest through habitat conservation and public awareness. This research has brought us to the point of purchasing Cottonwood Canyon and we are developing a conservation strategy for the entire Hahamongna to Tujunga Wildlife Corridor.

18. Planning and implementing the conservation of connectivity for wildlife in urban landscapes

Coast to Cleveland wildlife corridor: retrofitting an urban landscape to facilitate wildlife movement

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Urbanization in central Orange County, California, has separated a large bloc of protected coastal lands from any other open space. Genetic studies of Coastal Cactus Wrens and Bobcats confirm that the coastal populations are genetically distinguishable from other Orange County and Northern San Diego populations. A long-planned re-connection of coastal and foothills wildlife takes advantage of the closing of El Toro Marine Corps Air Station in Irvine. The central miles of the corridor will be graded and built along with adjacent new development during the extensive redevelopment of the base as the Great Park and Great Park Neighborhoods. Imposing a strip of restored natural habitats on a landscape with existing urban infrastructure and security issues calls for creative solutions. The animals need to negotiate roadways of all sizes, culverts designed for creeks, Amtrak rails, channelized water courses and abandoned airstrips; plus occupation of wildlife culverts by taggers and the homeless; and illegitimate dog-walking and other recreation. We will describe some of the obstacles and potential solutions; sharing our experiences and encouraging input from the attendees.

19. Urban large carnivores

King Of The Coast: Understanding Spatial Patterns Of Male American Alligators On A Georgia Barrier Island

Kimberly M. Andrews[1,2], Gregory M. Skupien[3], Richard G. Bauer[2], and Terry M. Norton[1]

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American alligators (*Alligator mississippiensis*) historically occupied freshwater habitats such as isolated wetlands, lakes, rivers, bottomland swamps, and floodplains in coastal and inland sites. Due to the loss of many aquatic habitats, alligators have resorted to inhabiting human-made lagoons on golf courses and other aquatic habitats in close proximity to developed areas. We conducted a three-year telemetry study of adult (>1.8 m) male alligators on Jekyll Island, Georgia, USA using VHF and GPS technology. Our objective was to test the efficacy of using VHF and GPS telemetry in the framework of understanding the spatial ecology of American alligators in a developed landscape. We found home range size and habitat use to be highly variable among males. We observed establishment of multiple core home range locations and critical habitat included both native and human-made systems, such as freshwater wetlands, marshes, golf course lagoons, and underground drainage systems. Transition habitats included maritime forests and oceans/beaches in addition to those used in their core ranges. Habitat usage and movement extent varied seasonally, peaking in spring breeding season. Understanding these behaviors of this important apex predator is critical to their management and conservation. Yet, extending awareness to the people who share these developed and semi-developed landscapes is perhaps the most critical part of the process. We employ multiple proactive approaches, such as education programs, written “how to” and “how-to-not” information, and training of local enforcement staff. We engage reactive approaches through a 24-7 wildlife response system and behavioral conditioning of habituated animals. However, while proven effective on short-term, local scales, we are concerned about the larger picture. We discuss some of our in-progress ecotoxicology research on three species of crocodilians in altered habitats in Georgia and Costa Rica as a case study on developing integrated management plans for crocodilians in developed areas.

Risky business: Black bear movement within developed landscapes

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As human development expands, it is important to understand how wildlife respond to developed landscapes. To evaluate adaptation to human development, we examined fine scale selection for anthropogenic landscape features among black bears within a developed landscape. Our objectives were to identify movement patterns indicative of perceived risk, or acclimation by testing for selection differences between seasons, according to reproductive status, and across development contexts.Hourly GPS data was collected from 23 female bears in 2013, 22 females in 2014, and 23 in 2015. Area-weighted mean housing densities within 95% kernel home ranges were between 2.36 – 214.43 houses/km^2. We used step selection functions to estimate selection for anthropogenic features, while accounting for natural habitat. Housing models included distance to local roads, and whether steps ended in developed land cover. Road models included distance to highways, and whether steps crossed highways. We fit separate models to summer (May 1 – Aug. 31) and fall (Sept. 1 – Nov. 31) movement data and ranked models using AIC for each bear. We compared selection coefficients for anthropogenic features between seasons and reproductive status using ANOVA, and as a function of development using mixed-effects regression. Bears avoided developed land cover, and local roads. Avoidance of local roads increased with increasing development. Developed land cover was selected only during the fall, among bears without cubs. Bears without cubs were also more likely to cross highways. These findings indicate that bears perceive anthropogenic features as risky, regardless of land-use context, and provide evidence against acclimation to development.

19. Urban large carnivores

Connectivity conservation for Tigers in a human dominated landscape

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High density wildlife habitats in India are surrounded by high human use areas and such an interface is fraught with man-animal conflict. The same is true for tigers, especially when their dispersal routes, very often, pass through areas of high human activity, posing a threat to humans and tigers alike. This study aims to investigate the use of areas outside protected forests and to characterize human-tiger conflict along potential movement corridors in the Eastern Vidarbha Landscape, in central India. We analyzed tiger presence and human-tiger conflict locations and regressed them against habitat variables to define the cost surface for connectivity analysis. We used Circuit Theory for corridor analysis. We mapped bottlenecks using centrality analysis and investigated the coincidence of conflict with occurrence of bottlenecks. Results show that tigers are using a much wider landscape than thought earlier. We found that there is high incidence of conflict in degraded stepping stone corridors and bottleneck areas. High number of conflict cases were reported from villages with high human and livestock population, and where agriculture and grazing was practiced adjacent to densely forested areas. Conflict occurrences also show significant difference across seasons and landuse classes. We recommend focused restoration of corridors and bottlenecks, and regulated grazing and agricultural activities near tiger corridors as the key to manage human-tiger conflict.

Conserving Mountain Lions in Southern California: Addressing fragmentation, conflict, and excess human-related mortality in comprehensive and collaborative ways

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Our team has been studying pumas (*Puma concolor*) in southern California since 2001, and has identified numerous threats to their long term survival. The study area is highly biodiverse, and includes landscapes as varied as coastal Mediterranean, high mountain, and desert, along with ~9 million people. Conserved lands vary from large blocks such as national forest to small peri-urban “wilderness” parks. Conserved lands are often separated by development and roads (including interstate highways) that create risks and barriers for pumas, and protected corridors between them are often not present. Because male puma ranges in the region average 375 km^2, and females half that, territorial circulation and dispersal often require crossing extensive areas of unprotected lands and frequent encounters with busy highways. This combination of circumstances has resulted in low annual survival (mean 56%) and genetic isolation. Long term survival of mountain lions in this landscape will be dependent on reversing isolation and mortality trends that currently exist, or will require active population manipulation in the future. To address the former, our project has engaged with a wide array of stakeholders and entities to collaborate, and provide comprehensive information and leadership, to improve conservation of these animals.These include collaborations that have or are currently: 1) Defining highest priority parcels for conservation, especially for corridors; 2) Defining high-risk highway crossing points and identifying solutions; 3) Designing highway crossings, fencing, jumpouts, etc, and providing construction oversight; 4) Advising planners, NGO’s, and wildlife agencies at all levels on connectivity challenges and solutions; 5) Improving domestic animal protection measures through education, outreach, and testing of predator deterrence methods, as well as sequentially surveying residents to assess the effects of these measures; 6) Developing best practices through expert workshops and other means for modification or creation of highway crossings, and long term monitoring of the population.

19. Urban large carnivores

Predictors of mountain lion body (*Puma concolor*) condition in the San Francisco Bay Area

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Anthropogenic habitat fragmentation and modification disproportionately affects animals with large home ranges with low population densities. For example, besides the natural variation in prey species between regions, seasons, and years, human disturbance also causes additional changes in prey composition, availability and health and thus, may negatively affect apex predators like pumas (*Puma concolor*). We used 540 photo sets and /or videos from 90 wildlife camera traps placed in or near San Francisco Bay Area NPS lands between 2012 and 2017 to determine how puma body condition scores vary spatially and temporally in a highly urbanized area. We found little variation in body condition between seasons and years, but found significant differences between geographical regions. Regions characterized by more fragmentation had pumas with higher body condition than average. Our finding may be explained by a higher density of deer or a change in preferred prey items in the fragmented landscapes, and/or because body condition is not the best predictor of health of pumas.

Puma (*Puma concolor*) survival in a fragmented landscape

Anna Nisi and Chris Wilmers

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Land use change and habitat fragmentation are key threats to large carnivore populations worldwide, and carnivores that live in human-dominated areas are at increased risk of anthropogenic mortality. However, populations of some large carnivore species are able to persist in fragmented and human-dominated landscapes, so it is unclear to what degree individual-level costs associated with living in a fragmented environment have consequences for population dynamics. The Santa Cruz Mountains is a variegated landscape that contains rural, suburban, and urban areas, and supports a resident puma (*Puma concolor*) population that experiences high levels of anthropogenic mortality. Working with data from this population from 2008-2017, I conducted a survival analysis to characterize the relationship between habitat fragmentation and adult puma survival.I will present preliminary results from this analysis, which integrates spatial data from collared pumas into a Cox proportional hazards model to investigate whether housing density within an animal's home range impacts overall and cause-specific survival probabilities. I will also describe how temporal scale in home range calculation influences those relationships, and discuss how Bayesian methods may be used to determine whether anthropogenic mortality is additive or compensatory in this population.

19. Urban large carnivores

Individual and Population Level Resource Selection Patterns of Mountain Lions Preying on Mule Deer along an Urban-Wildland Gradient

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Understanding population and individual-level behavioral responses of large carnivores to human disturbance is important for conserving top predators in fragmented landscapes. However, previous research has not investigated resource selection at predation sites of mountain lions in highly urbanized areas. We quantified selection of natural and anthropogenic landscape features by mountain lions at sites where they consumed their primary prey, mule deer (*Odocoileus hemionus*), in and adjacent to urban, suburban, and rural areas in greater Los Angeles. We documented intersexual and individual-level variation in the environmental conditions present at mule deer feeding sites relative to their availability across home ranges. Males selected riparian woodlands and areas closer to water more than females, whereas females selected developed areas marginally more than males. Females fed on mule deer closer to developed areas and farther from riparian woodlands than expected based on the availability of these features across their home ranges. We suggest that mortality risk for females and their offspring associated with encounters with males may have influenced the different resource selection patterns between sexes. Males appeared to select mule deer feeding sites mainly in response to natural landscape features, while females may have made kills closer to developed areas in part because these are alternative sites where deer are abundant. Individual mountain lions of both sexes selected developed areas more strongly within home ranges where development occurred less frequently. Thus, areas near development may represent a trade-off for mountain lions such that they may benefit from foraging near development because of abundant prey, but as the landscape becomes highly urbanized these benefits may be outweighed by human disturbance.

Landscape and habitat use for a large carnivore in the city: use and selection for mountain lions around Los Angeles

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Although some species of wildlife can adapt to and even thrive in urbanized areas, many species are rare or absent there. Large carnivores have some of the largest spatial requirements of any animal, and they have generally been thought to be incompatible with cities. However, in and around Los Angeles, the second largest metropolitan area in the U.S., mountain lions (*Puma concolor*) still persist despite the significant challenges. At Santa Monica Mountains National Recreation Area, we have been studying the behavior, ecology, and conservation of mountain lions since 2002. Here we analyze mountain lion landscape use and selection across the complex urban landscape of southern California using more than 125,000 GPS locations from 30 collared animals over 14 years. In general, mountain lions were rarely in developed areas, as their home ranges consisted on average of just 3% urban and 10% unnatural areas (urban plus "altered open" areas such as golf courses, low density residential areas, landscaped parks, *etc*.). However, there was significant variation between age and sex classes, and between individuals. Adult females had the smallest percentage of urbanized areas, at 0.8%, whereas subadult males had the highest, at 3.6%. Two adult males, P22 and P41, lived in highly circumscribed parklands, and they had some of the smallest adult male home ranges (24 and 54 km^2) ever documented, and in our study by far the greatest use of urban areas, at 17.4%, and unnatural areas, at 26.4%. Interestingly, patterns of resource selection were different, in that all age-sex classes strongly selected areas near urbanization, with the exception of adult males, which strongly selected chaparral and riparian woodland areas. Subadults and females may be taking advantage of deer presence near developed areas while avoiding adult males. These results have important implications for mountain lion conservation and management in urban landscapes.

19. Urban large carnivores

Cougar Safe Trek: Leading the Next Generation of Wildlife Protection Along Highways – The Case of State Route (SR) 241 Wildlife Fence in Orange County, California

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Estimates suggest that less than 30 adult cougars (*Puma concolor*) remain within Southern California's 800-square mile Santa Ana Mountain Range, between Los Angeles and San Diego. Threats include wildlife-vehicle collisions, genetic restriction, and habitat loss and fragmentation. Vehicle collisions are particularly concerning because of low annual cougar survival rates in the region, impacts to human health, and economic implications. The University of California Davis (UCD) Road Ecology Center estimates the total annual cost of wildlife-vehicle collisions in California at approximately $225 million for 2015, including lost animal value, property damage, minor and major injuries, and fatalities. In Orange County the average cost per vehicle-collision is likely higher than the national or state average due to higher vehicle repair and medical costs in this region. Part of the solution is appropriately designed wildlife crossings coupled with effective exclusionary fences. The Foothill/Eastern Transportation Corridor Agency teamed up with the UCD Wildlife Health Center, UCD Information Center for the Environment, the U.S. Fish and Wildlife Service, and Feremenga, Vickers, McFall and Huber the California Department of Transportation to design a state-of-the-art wildlife protection fence along a six-mile portion of SR-241in the Santa Ana Mountains foothills to complement existing wildlife undercrossings. The UCD team studied the behavior and movement of wildlife along SR-241 with cameras, analyzed data from GPS-collared cougars, documented intrusions and mortalities along the roadway, modeled crossings, and conducted an on-the-ground examination of the roadway, undercrossings, and right-of-way fencing. Due to the ease with which wildlife continued to cross the roadway at-grade, UCD recommended the construction of a new and improved wildlife fence to direct animals to undercrossings. The resulting award-winning wildlife fence emphasizes an innovative and creative approach to effective wildlife fence design, type, and location that reduces human-wildlife conflict along SR-241, and reduces risks to the cougar population in the area.

Integrating habitat use and movement across space and time to create a multi-level, multi-scale conservation plan for puma in Southern California

Kathy A. Zeller[1], T. Winston Vickers[1], Holly B. Ernest[2], and Walter M. Boyce[1]

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Urbanization and roads are increasingly isolating puma populations in southern California. Genetic analyses have shown the Santa Ana puma population has very low genetic diversity and is the most isolated population in California. A comprehensive conservation network is needed to inform management, mitigation and conservation actions. We use puma (*Puma concolor*) data from a long-term study in southern California to integrate GPS telemetry and genetic data into a multi-level, multi-scale conservation plan. We first generated two multi-scale resource selection functions from GPS telemetry data; a home range selection function and a point selection function. We combined these into a single resource selection surface that accounted for both home range establishment and resource use within the home range, from which we identified resource use patches. We then generated two multi-scale resistance surfaces; one derived from a Path Selection Function and one from a landscape genetic analysis. We combined these into a single resistance surface for connectivity modeling that reflected both short-term, finite movements, and generational movements that resulted in successful breeding. We modeled connectivity across our study area using resistant kernels and predicted road crossing locations using empirical crossing locations and factorial least-cost paths. We summarize our results within a conservation-planning framework for puma across northern San Diego and southern Orange and Riverside Counties.

20. Urban partnerships - appreciation and conservation of wildlife

The Urban Wildlife Conservation Program and San Diego National Wildlife Refuge

Chantel Jimenez (Environmental Education Specialist)

San Diego National Wildlife Refuge, U.S. Fish and Wildlife Service, Carlsbad, CA

The U.S. Fish and Wildlife Service's (Service) Urban Wildlife Conservation Program has thoughtfully and deliberately invested in communicating the vital importance of wildlife conservation to urban audiences. The long term trend is clear: our country is becoming more diverse and urbanized, requiring us to focus our efforts on educating and engaging urban communities in conserving and protecting our nation' s wildlife heritage and biological richness. Refuges close to highly-populated areas provide the greatest opportunity to engage new and diverse audiences, whether through an Urban Wildlife Refuge or Urban Wildlife Refuge Partnership. Urban Wildlife Refuges provide the unique opportunity to strategically build an urban conservation community that treasures the nature both in their backyard and the National Wildlife Refuge System. In 2014, the San Diego National Wildlife Refuge Complex received an increase of $1 million in base funds to create the SoCal Urban Wildlife Refuge Project to educate urban communities about the importance of conservation and inspire people to become tomorrow' s stewards of the environment and be aware of their impact on the world around them. Our work has engaged communities from Ventura County, in Los Angeles along the LA River, and formed a new partnership in San Diego. The Project delivers the message that conserving wildlife and natural habitats sustains healthy communities and gives citizens opportunities to make a difference for wildlife, habitats and people too. The presentation will highlight the Project' s accomplishments, lessons learned, and the evaluation process the Service is using to measure success based on the Urban Wildlife Refuge' s Standards of Excellence.

An Urban Approach: The Don Edwards San Francisco Bay National Wildlife Refuge

Chris Barr, Deputy Refuge Complex Manager

San Francisco Bay National Wildlife Refuge Complex, U.S. Fish and Wildlife Service, Fremont, CA

The original plan in the late 1960s for establishing a National Wildlife Refuge in South San Francisco Bay was titled "An Urban Approach", highlighting the unique opportunity to create a natural oasis within a metropolis of 4.5 million people. At that time, the health and viability of the San Francisco Bay estuary was threatened by rampant development and pollution, and the U.S. Fish and Wildlife Service recognized the value of a new refuge "not only for the sake of wildlife alone" but also for "the provision of recreational and environmental benefits to man...as an important part in stimulating Americans toward saving a dying environment". Since that time, efforts by citizen groups and conservation organizations have restored San Francisco Bay to a vibrant, thriving estuary surrounded by more than 7 million people living in three major cities and more than 100 communities across 9 counties along its shoreline. The USFWS now owns and manages more than 30,000 acres of public lands managed as part of the Don Edwards San Francisco Bay National Wildlife Refuge in the heart of Silicon Valley. Much of our land is literally at the back door of multiple ethnically and economically diverse communities, positioning us to provide hands-on, multi-sensory experiences that connect urban youth and adults alike to nature and prepare them to become agents for positive change in their communities that benefit fish, wildlife, plants and their natural habitats. We serve as a trusted resource as wildlife managers and environmental educators helping our urban neighbors and partners meet the challenges of the 21st century, and local communities see us as a good neighbor and a safe sanctuary where they can renew a sense of wonder in the natural world. This presentation will highlight many of our long-standing urban education and outreach activities, as well as feature untapped opportunities to engage new groups of urban dwellers and broaden our connected conservation constituency in the San Francisco Bay Area.

20. Urban partnerships - appreciation and conservation of wildlife

Connecting People to Nature Through Birding and Bird Conservation: The Urban Bird Treaty Program

Roxanne E. Bogart

Urban Bird Treaty Program National Coordinator, U.S. Fish and Wildlife Service, Hadley, MA

The U.S. Fish and Wildlife Service's (Service) Urban Bird Treaty (UBT) program brings together citizens, federal, state and municipal agencies, and nongovernmental organizations to conserve birds through habitat conservation, education and outreach, citizen science, and hazard reduction efforts. Given that 80% of the U.S. population lives in metropolitan areas, and birds represent many urban residents' sole connection with wildlife, the UBT program provides a great opportunity to connect people with nature and create a connected and motivated urban conservation citizenry. Metropolitan areas provide important bird habitats, particularly for the millions of migrating birds that fly through these areas during spring and fall and need fall out habitats to rest and refuel. But cities also contain a host of threats, especially building glass and lights, which present serious collision hazards. Annual mortality resulting from window collisions with building glass in the U.S. is estimated to be between 365-988 million birds, mostly songbirds. Thus it's critical that urban and suburban areas be made as bird-friendly as possible through on-the-ground partnerships and programs like the UBT program that supports them. The goals of the UBT program are to protect, restore and enhance urban and suburban bird habitats; reduce hazards to protect birds; and educate and engage citizens in caring about and conserving birds and their habitats. There are currently 27 UBT cities throughout the country. The Service provides funding through a small grants program to qualified cities as well as technical assistance to city partners to develop and carry out community-based bird conservation projects and to become designated as Urban Bird Treaty cities. Any UBT or non-UBT city can apply for grant funds of up to $50,000, which are available through the National Fish and Wildlife Foundation's Five Star and Urban Waters Restoration Program, with a match requirement of 1:1. Examples programs from various UBT cities will be discussed in detail.

Cultivating Connectedness

Kristin Shaw, Urban Conservation Coordinator

Eastern Tallgrass Prairie and Big Rivers Landscape Conservation Cooperative, Bloomington, IN

Today more than 80% of Americans live in urban areas and by 2050 it is estimated that 70% of the world' s population will call a city 'home'. Our cities are built on lands and river systems thatconnect to larger natural areas. The protection of that land and water is vital for a city' s economy and the health and well-being of its urban residents. Ecological Places in Cities, EPiC Network, is a network of cities and conservation groups working together towards a new vision that integrates nature' s benefits and natural defenses with the needs of our urban future. We use advanced urban planning approaches along with innovative civic leadership to ensure that urban nature and our future generations can grow and thrive together. Learn about what the Landscape Conservation Cooperatives, the EPiC Network, and urban conservation across the Midwest.

20. Urban partnerships - appreciation and conservation of wildlife

A Monarch's View of a City: A Multi-City Landscape Conservation Design

Abigail Derby Lewis (Chicago Region Senior Program Manager)

Keller Science Action Center, The Field Museum, Chicago, IL

Monarch butterfly habitat—including milkweed host plants and nectar food sources—has declined drastically throughout most of the United States. Observed overwinter population levels have also exhibited a long-term downward trend that suggests a strong relationship between habitat loss and monarch population declines. Preliminary research results from a U.S. Geological Survey led effort indicate that we will need a conservation strategy that includes all land types to stabilize monarch populations at levels necessary to adequately minimize extinction risk—and urban areas will likely play a critical role. This strategy will need to reflect an integrated and interdisciplinary approach, one that includes ecological and social dimensions specific to an urban landscape. Learn about the effort underway to develop the very first urban conservation design for monarchs along the central flyway. The overall project is comprised of four components, including: 1) development of an Urban Monarch Conservation Framework that identifies strategies and design elements for habitat creation and community outreach, 2) development of city-based landscape conservation design to guide actions for the monarch butterfly in four cities that provide benefits both socially and ecologically, 3) implementation of demonstration projects based on the city-based landscape conservation design, and 4) a workshop that integrates individual landscape conservation designs into a cross-regional approach. Insights into the urban landscape conservation design process to date, strategies for outreach and Monarch habitat designs at multiple scales, geospatial tools will be shared, and lastly find out how your city could be a part of the urban monarch conservation movement!

21. Roads and urban wildlife

Effects of habitat enhancement on culvert use by small mammals

Debra Shier and Emily Gray

San Diego Zoo Institute for Conservation Research, San Diego, CA

The response of species to fragmentation in urbanized landscapes has been the subject of much recent research. Human development into pristine habitats typically begins with roads. Roads affect wildlife through direct effects such as habitat loss and mortality from vehicle strikes as well as indirectly via habitat degradation, decreased landscape connectivity due to road avoidance and alterations in species space use. It is widely understood that retaining natural remnant corridors of habitat is a useful and practical conservation measure, which can ameliorate the effects of habitat loss and fragmentation on wildlife. Corridors may facilitate the movement and exchange of individuals among isolated remnants and assist in maintaining gene flow and populations. Such corridors may be most effective if they are of sufficient size and habitat quality to encourage use by the target species, but for many species, optimal corridor size and design are unknown. We examined the effect of habitat enhancement on culvert use in small mammals in San Bernardino County by utilizing culverts that were part of a new road segment. We assigned each culvert to one of two treatment groups: enhanced or not enhanced. Habitat enhancement included randomly placing dry shrubs as cover throughout the length of the culvert and spreading kangaroo rat scent and seed. We used remote cameras positioned throughout the length of the culvert to quantify visitation rates and determine whether animals were moving through the entire length of the culvert. After year 1, we flipped the treatments in each culvert to increase the sample size. We found that several species of small mammals used the culverts and that habitat enhancement significantly increased use. Our results indicate that designing new roads with culverts, including habitat enhancement is an effective way to maintain habitat connectivity and reduce road kill in small mammals.

21. Roads and urban wildlife

The truth about roadkill: injury, cruelty and human responses

Kathryn Harrold[1], and Fraser Shilling[2]

[1]Independent Wildlife Consultant; [2]Department of Environmental Science and policy, University of California, Davis

Wildlife-vehicle collisions (WVC) are assumed to result in death for every animal involved, or the fate of the animals is unquestioned. We present evidence of widespread injury of animals involved in WVC, based on law-enforcement records. We extracted >5,950 WVC records from ~563,000 traffic incidents on state highways in California over a 12-month period (2015-2016). We found that of collisions with mule deer (91% of reported incidents) 22% animals were left with injuries on the road; in fact detailed records show some were left with severe injuries for many hours. In addition, for another 26% of the animals the outcome was unknown, often due to the officers involved reporting not being able to find the animal. Approximately 3% of animals remained injured in place until an officer could come to dispatch (shoot) them. Animal cruelty laws in California apply to domestic animals, but they have not been used in the case of wildlife. Details from law enforcement reports describe scenes that would be unacceptable in the case of domestic animals. For example, the officer says in these cases: 1) baby deer, reporting party very upset that is has a broken leg and is suffering; 2) 1 deer alive, injured in ditch...2 deer [with broken] leg will need to dispatch; 3) deer on rs but alive and inj unable to get up / was trying to crawl into lanes; and 4) injured deer in middle of rdway/ struggling. In many cases, people were reported to have stopped, re-directed traffic around the injured animal, were visibly upset, and in some cases attempted to take wounded wildlife for emergency veterinarian care. To reduce impacts to animals and involved people, we propose that this aspect of WVC, animal injury, should be addressed through legislative policy and management responses.

Exploring and Predicting Elevated Vertebrate Road Kill From Ventura County to Louisiana to the Middle East

Sean Anderson

Environmental Science and Resource Management Program & Pacific Institute for Restoration Ecology, California State University Channel Islands, Camarillo, CA, 93012

Roads and vehicles have profound impacts on the abundance and distribution of vertebrates, with direct mortality (*i.e.* “road kill”) the most obvious such effect. My students and I have been examining road kill across the globe (eastern Turkey, coastal Gulf of Mexico, and here in coastal California) since 2007. Individual species killed varies across the planet, but overall mortality is consistently elevated along ecotones or edges. Patterns are clearest within our most intensively-sampled region: in/around Ventura County, California (>6,000 observed kills during >6,000 individual surveys amounting to >75,000 km driven over the past decade).While many factors such as land use, roadside barriers, maximum speed limits, and vehicle traffic correlate with kill rates, gross positioning of the particular road segment within transition zones (wildland-urban interface, etc.) is a key predictor. In the Santa Monica Mountains 4,944 ± 622 (mean ± se) medium- to large-bodied vertebrates are killed annually on major roads, spanning abundant (*e.g.* 98 coyote kills), common (*e.g.* 9 owl kills), and rare (*e.g.* 3 badger kills) species of concern. Kill rate along the range’s perimeter exceeds that within its core. We see the same patterns in California’s Santa Ynez Mountains, Asia’s Caucasus Mountains, etc. Roads within/proximate to wetlands and riparian corridors foster much higher mortality than all other ecological communities combined. Road kill has proven to be a powerful way to engage the public in conservations about ecological fragmentation, connectivity, and wildlife corridor issues. Better wildlife crossings and related efforts to safely allow dispersal and movement across road-rich areas can greatly limit mortality.

CalTrans District 11 – Wildlife Connectivity

Bruce April and Kim Smith

CalTrans, District 11, San Diego, CA

California along with other states and nations are becoming more aware of the importance of connected habitats to ensure the existence of wildlife and biodiversity. Linear transportation projects can have significant impacts on both regional and local wildlife corridors. Caltrans District 11 has implemented several projects that incorporate wildlife connectivity features into the project design early to improve connectivity. Some examples include the Interstate 5 North Coast Corridor, Interstate 15 Managed Lanes Project and the State Route 76 Widening Project. In addition, Caltrans is partnering with the resource agencies and local stakeholders on studying connectivity along highway corridors that have been identified as constrained for wildlife (SR-94 and SR-67) in order to better inform future project decisions. A recent project on State Route 76 in northern San Diego County involves the widening of a two-lane roadway to four-lanes along a 5-mile segment. The San Luis Rey River runs parallel to the alignment and facilitates both local and regional movement of wildlife species, including large mammals such as mountain lion and mule deer to smaller mammals, reptiles and amphibians. Caltrans is required by permits to install wildlife crossings, directional fencing and jumpouts. A wildlife crossing study was conducted within the project limits to determine areas within the roadway that had increased levels of roadkill. Factors such as connecting areas of open space and matching the hydrologic needs of the project were also used to determine where to place wildlife undercrossings within the project limits. In addition, crossings were also designed to meet different target species needs (small, medium, large). Caltrans would like to present the results of this movement study as well as lessons learned.

Integrating Fish & Wildlife Considerations into Transportation Projects

Amy Golden and James Henke

CalTrans, Office of Biological Studies, Sacramento, CA

Transportation projects are often developed early on with inadequate funding, resourcing, and data available for the consideration of aquatic and wildlife movement into early project scoping. This leads to missed opportunities to reduce the incidence of wildlife-vehicle collisions and improve permeability of roads with transportation projects for wildlife passage. The goal of the presentation will be to provide a high-level overview of key fish and wildlife habitat considerations that Caltrans considers during decision-making points with transportation planning, wildlife mitigation development, and early project development. Caltrans staff will give an overview of the challenges and opportunities at a large infrastructure agency to promote wildlife passage with transportation projects. Caltrans staff will highlight a few District case studies that have implemented wildlife connectivity improvements along with bridge and culvert rehabilitation projects and roadway safety projects on the State Highway System. Caltrans staff will discuss the gradual changes that are taking place in the State Highway Operation and Protection Program (SHOPP) to encourage multi-objective planning and funding decisions and alignment with Caltrans 2015-2020 Strategic Management Plan and Sustainability Goal. Lastly Caltrans will discuss efforts being made to align ecosystem services with asset management (e.g. pavement, bridges, and culverts) and SHOPP transportation project funding opportunities.

22. Ethical wildlife control

Out of control wildlife control; the importance of utilizing more humane and effective approaches

John Griffin

The Humane Society of the United States, Washington, DC

The wildlife control industry in the U.S. has come a long way from its origins in recreational trappers helping overburdened wildlife agencies with wildlife control requests from the public in return for the pelts of the animals trapped. Now a modern day multibillion dollar industry, the methods of control that dominate have not come as far as the market has, and fall short of expectations in both humaneness and efficacy. Advancements in understanding conflicts with wildlife and in the improving methodology and application of existing tools and approaches to wildlife damage management increase both effectiveness and humaneness; reduce the number of animals killed; and resolve conflicts for longer periods of time. The implications of employing these tools and methods on a wider front in the context of "nuisance" wildlife control services represent an opportunity for significant progress. It is significant not only for the millions of animals a year that are caught up in "control" measures, but also for the public and the communities experiencing conflicts and looking for long-term resolution. This presentation will review animal damage management in the context of the call to establish humane and effective standards by animal protection and welfare agencies around the world, the public, and increasingly by the scientific community. This presentation will also provide an overview of the state of humane wildlife control today and serve as an introduction to the related talks in the session.

Not shaken or stirred, but covered in corn oil: Why aren't we addling more Canada goose eggs?

Lynsey White Dasher (Director, Humane Wildlife Conflict Resolution)

The Humane Society of the United States, Gaithersburg, MD

Although almost decimated by hunting and habitat loss in the U.S. in the first half of the 20th century, the restocking and relocation of captive-bred populations of Canada geese (*Branta canadensis*) in the 1960s has resulted today in an abundance of resident (nonmigratory) geese in many communities throughout the lower 48 states. With hunting not being a viable option for curbing population growth in urban and surburban areas, community leaders increasingly find themselves in the position of devising a plan to address the concerns of residents who have grown wary of dodging goose droppings in their local parks, lakes, and ball fields. A tactic commonly used is to round up, remove, and kill Canada geese and goslings in public parks and properties during their annual molt. Although seen as a quick fixsolution, these roundup programs are often met with intense public opposition and have questionable results (usually needing to be repeated on a yearly basis). An alternative approach (that can be used either separately, combined with nonlethal approaches such as aversive conditioning, or can even be used in conjunction with roundups) is to reduce the population of resident Canada geese by addling their eggs (and preventing the hatching of goslings). Egg addling programs are effective, inexpensive, and community-building efforts, yet are not in place in most communities experiencing conflicts with Canada geese. This presentation investigates why this is the case, and how we can improve solutions for solving conflicts between people and Canada geese in urban and suburban areas in the U.S. as we move forward.

Predator-Proofing Tips and Tricks

Sharon Ponsford

Sonoma County Wildlife Rescue, Sonoma, CA

Predator species, from raccoons, opossums and skunks to larger carnivores like the coyote and mountain lion, can pose a significant threat to pets and livestock when they are not adequately protected. Traditional response has been to remove the offending predators, but, based on results from a growing number of trade professionals specializing in non-lethal control, removing the animals is rarely a lasting solution. When focus shifts from an offending animal onto the actual cause of conflict, the key to solving the problem becomes clearer, and, as research suggests, most situations call for a change in human behavior in addition to environmental controls. This presentation will showcase field-tested methods used by industry leaders to prevent depredation, with tips and tricks to reducing predator presence in both urban and rural areas. We believe this informations will be valuable to practitioners interested in non-lethal options, and helpful to land managers and civic leaders seeking lasting alternatives to lethal control of predators.

PEEP - An Interactive Living Laboratory

Danielle Mattos

Sonoma County Wildlife Rescue, Sonoma, CA

In addition to answering hundreds of calls about wildlife each month, in 2016, non-profit Sonoma County Wildlife Rescue launched an innovative program to help people with wildlife conflicts. This living learning lab allows members of the community to see how relatively simple it can be to protect their property from wildlife pests, like how to build an exclusion device to keep animals out, or a catio to let cats experience the outdoors without risk. This live lab uses only "wildlife friendly" techniques and is the first of it's kind in the United States. This presentation will discuss how this program went from concept to reality and how it’s giving back to the community, both human and non-human.

Impacts to Nontarget Wildlife from Rodenticide Use in Urban Areas

Stella McMillin

California Department of Fish and Wildlife, Wildlife Investigations Laboratory, Rancho Cordova, CA

The California Department of Fish and Wildlife investigates cases of pesticide exposure and intoxication in wildlife. The majority of these incidents are currently caused by rodenticide use in urban areas by both professional and residential users. In California the majority of scavenging and predatory wildlife tested has been exposed to anticoagulant rodenticides, likely through secondary exposure. Most cases involve second-generation anticoagulant rodenticides, which are only available to certified applicators in California. Bromethalin, an acute rodenticide, has caused intoxication of urban wildlife, such as raccoons, skunks, and gray foxes, likely through primary exposure. Although bromethalin product labels specify use in a bait station, loose bait may be purchased. It is likely that the incidence of bromethalin intoxication could be reduced by requiring bromethalin only be available in tamper-resistant bait stations. Cases of intoxication by the acute rodenticides strychnine and zinc phosphide are less common and appear to result from misuse of the products. Trends in wildlife/pesticide incidents and possible mitigation measures will be discussed. Reliance on chemical control of vertebrate pests, without including other elements of Integrated Pest Management, such as exclusion and sanitation, leads to widespread exposure in non-target wildlife and is an ineffective long-term strategy.

22. Ethical wildlife control

Barn Owls as Natural Pest Control

Doris Duncan

Sonoma County Wildlife Rescue, Sonoma, CA

Barn owls are efficient hunters of nocturnal mammals - rats, mice, voles and gophers. As cavity nesters, they take readily to wooden structures on a pole and use them as nest boxes to raise their young, even in urban areas, making them an excellent option for controlling rodent populations naturally. Sonoma County Wildlife Rescue's Barn Owl Maintenance Program (BOMP) provides barn owl nest boxes and monitors their activity. This presentation will look at how installing nest boxes benefits barn owls by providing them valuable roosting and nesting sites, and how the owls benefit their community by providing rodent control.

Introducing RatX

Jarid Gardner

EcoClear Products, Florida

In 2008, after a comprehensive safety review of rat and mouse poisons, the United States Environmental Protection placed restrictions on the availability and
use of certain rodenticides to reduce risks to humans, pets, and non-target wildlife. In 2014, the California Department of Regulation also set restrictions on the purchase and use of baits that contain brodifacoum, bromodialone, difenacoum, and difethialone (2nd-generation anticoagulant rodenticides or SGARs). Although the new regulations reduce availability of these poisons to consumers, they are still widely used in the pest control industry. RatX® was created to provide consumers and pest control operators with a safer alternative. RatX® was formulated around the unique digestive system of rats and mice, where the caecum (sack between large and small intestine) plays an active role. Essentially, as the grain-based pellets are digested, RatX disrupts the message system to the rodent's brain, causing it to stop drinking. This leads todehydration, blood thickening, kidney dysfunction, coma and eventual death within two to four days. During the time it takes to kill the rat or mouse, if a pet or predator kills and eats the rodent, it will not be exposed to any harmful chemicals - RatX is 100% safe for people, pets and wildlife. This presentation will detail how the product works and its benefits to consumers and the pest control industry.

Implementing an Effective Community-Supported Ordinance to Secure Trash from Black Bears: A Case Study from Boulder, Colorado

Valerie Matheson

City of Boulder Planning, Housing and Sustainability, Boulder, CO

Like many other communities, the City of Boulder (population 102,420) has experienced increased bear-trash conflicts. In 2014 four bears were killed in the city due to public safety concerns and community support increased for new laws requiring trash to be secure from bears. The three-year journey to establishing community-supported laws that require trash to be secured from bears consisted of stakeholder collaboration; increased community awareness about the association between unsecured trash and bears being killed; addressing obstacles such as increased costs; and a feasible enforcement strategy. Implementation of the new requirements was phased, and required approximately 6,000 waste carts to be bear-resistant as of October 2014, and an additional 8,700 carts and 460 dumpsters were required as of June 15, 2016. Implementation of the new ordinances has substantially decreased bears' ability to access trash in Boulder and brought a welcome increase in the cleanliness of the community.

22. Ethical wildlife control

Making A Killing Without Killing

Rebecca Dmytryk

Humane Wildlife Control, Moss Landing, CA

Urban areas are modernday ecosystems where wild animals like raccoons,skunks, opossums and coyotes can thrive due to the year round abundance of resources food, shelter and water. Many wildlife conflicts can be permanently resolved by eliminating the animals' access to these resources. This presentation will explore strategies for addressing wildlife conflicts using nonlethal control methods, like eviction, exclusion and use of deterrents. Case studies will help demonstrate the successfulness of various methods of resolving nuisance wildlife problems, highlight the differences in time and cost. We will also look at theadvantages and disadvantages of lethal versus nonlethal control, including ecological concerns, ethical considerations, and consumer response, with emphasis on how providing nonlethal wildlife control services is not only an environmentally and ethically sound choice but a profitable one.

What if everything you thought you knew about 'feral' cats was wrong?

Peter J. Wolf

Best Friends Animal Society, Kanab, UT

Among the many topics discussed under the broad category of urban ecology, few are as contentious as the management of unowned free-roaming (“feral”) cats. Like any public policy, the policies intended to effectively manage the population of these cats must, in addition to meeting other criteria (e.g., reflect broad public interest, economic feasibility, etc.), be based on sound science. Although many communities across the country have implemented programs based on the trap-neuter-vaccinate-return (TNVR) method of managing “feral” cats, such efforts are often met with significant opposition by those claiming to have science on their side. Careful scrutiny of the studies typically cited in support of these claims, however, reveals a troubling pattern of careless research design and methods, flawed analyses, and dubious conclusions. Public policy justified by such work is likely to prove costly and ineffective, and will very likely increase any legitimate threats these cats pose to wildlife, the environment, and public health. In this presentation, I will: (1) examine some of the most common claims made by TNVR opponents, (2) offer compelling evidence to challenge these assertions, and (3) argue that policies opposing TNVR actually exacerbate the threats to wildlife, the environment, and public health.

An Objective Road Risk Assessment Method for Multiple Species: Ranking 161 Reptiles and Amphibians in California

Cheryl S. Brehme and Robert N. Fisher

Western Ecological Research Center, U.S. Geological Survey, 4165 Spruance Road, Ste. 200, San Diego, CA 92101

Our primary goal was to provide Caltrans and other transportation planning agencies the needed guidance to prioritize mitigation efforts for amphibian and reptile species in California. This involved assessment of over 160 species of frogs, toads, salamanders, snakes, lizards, and chelonids (turtles, tortoise). Subspecies were included if they had special federal or state protection status. Rankings such as these can be easily biased according to the availability of species road-related literature or toward iconic and favored study species. We attempted to assess risk across all species in an objective manner informed by current road ecology literature. Therefore, scoring was based upon a suite of life history and space-use characteristics associated with negative road effects. Chelonids and large bodied snakes were the highest risk groups, with 100% of chelonid species and 74% of snake species at high or very high risk from roads within their terrestrial and/or aquatic habitats. Fifty-five percent of toad species and 45% of frog species were ranked as high or very high risk, while only 17% of salamanders and 14% of lizard species were at high risk from negative road impacts. This assessment helped to confirm the presumed risk for many species but also highlighted the need to focus on previously overlooked species. In conjunction with this, specific roads of concern were identified and mapped for all high risk species. This information will be used to inform future road planning and mitigation efforts such as need for wildlife crossings and barrier structures. We believe this will be a useful tool for wildlife management and transportation agencies that can be easily applied to other wildlife species and locations.

Acknowledgements: This study was funded by Caltrans (California Department of Transportation).

Geckos in the 'Hood: Rapid Continental Spread and Local Adaptation of an Urban Invasive Reptile

M.M. Dickson[1], G.C. Larson[1], S.A. Zimmermann[1], T. Wolfmeyer[1], H.E.M. Liwanag[2], G.B. Pauly[1,3], and R.E. Espinoza[1,3]

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Invasive species often provide novel insights into adaptive evolution. Introduced species are likely to rapidly adapt to new local climates because of small founder populations and strong selective pressures in their new environments. Ectotherms may be particularly sensitive to climatic challenges, requiring swift adaptive change. To test these ideas, we compared body sizes, thermal tolerances (*CT*min and *T*pant) and temperature-dependent rates of evaporative water loss (EWL) and resting metabolism (RMR) of invasive populations of Mediterranean House Geckos (*Hemidactylus turcicus*) from climatically distinct regions across the USA. These geckos first appeared in Florida in 1910 and have subsequently colonized 24 states. We first documented their temporal spread via GIS. Next, 10 populations were studied from across the USA representing three climates (summer/winter): desert (hot/cold, dry; $n = 3$ populations), Mediterranean (warm/moderate, dry; $n = 2$), and subtropical (hot/cool, humid; $n = 5$). We hypothesized that geckos would exhibit phenotypic differences consistent with adaptation to local climates. Geckos from drier climates were smaller, and those experiencing cooler daytime temperatures had lower *CT*min compared to those from hotter climates. We found no differences in *T*pant among populations. At higher body temperatures, arid-climate geckos had rates of EWL that were two-thirds the EWL of geckos from humid climates, which was explained by correspondingly lower RMR in the arid populations. Interestingly, a recently founded (~3 yr) Mediterranean population did not show evidence of local adaptation. Ultimately our data will be used in a combined mechanistic and species distribution model to predict the potential range expansion of this species in the USA.

23. Invaders and survivors: Reptiles and amphibians in urban ecosystems

Lizards Without Borders: Comparing Thermal Physiology Between Introduced, Urban Populations of the Italian Wall Lizard (*Podarcis siculus*) in New York and California

Daniel Haro[1], Katherine Holst[1], Gregory Pauly[2], Russell Burke[3], and Heather E.M. Liwanag[1]

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When introduced to a novel environment, nonnative species must quickly adapt to environmental conditions in order to establish a population. One of the most important abiotic features of the environment for ectothermic animals is temperature, which greatly influences both physiology and behavior. The Italian Wall Lizard (*Podarcis siculus*, IWL) has been introduced to several urban and suburban sites in the U.S. since the 1960's. Of these populations, the New York and California lizards have been geographically separated from their source populations for 50 and 23 years, respectively. With regard to average annual temperatures and magnitude of seasonal changes, these two environments differ both from each other and from the native environment. For example, minimum winter temperatures in New York average 20°C colder than in the source population's environment in Florence, Italy. Is the successful establishment of these populations due to pre-existing traits, rapid adaptation through selection, plasticity, or some combination of the three? To begin to address this question, we are measuring thermal tolerances and thermal preferences of lab-acclimated IWL from the New York (n=25) and California (n=29) populations. Our goal is to determine whether there is evidence of fixed evolutionary adaptation to their novel thermal environments. We hypothesize that these populations are able to survive in novel environments through plasticity of thermal physiology traits. As a result, we expect to see no fixed differences in thermal tolerance and thermal preference between our groups. To investigate the effects of environmental acclimation, future work will investigate how variable these traits are across seasons in wild populations. To determine the role of pre-existing and evolutionary adaptation, we will compare our findings to those of the respective source populations.

Poor Land Management Practices Impact Herpetofaunal Biodiversity Within Urban Habitats

Brian Hinds

Herpetological Education & Research Project, 14530 Mulberry Dr., Whittier, California

Everyday we are losing biodiversity and suitable urban habitats due to poor land management choices. Many species of reptiles and amphibians are wiped out during "Restoration" projects, fire and weed control projects, and clean up details. This is typically because biologists and managers look at brown fields and invasive grass patches as low or no biodiversity value without conducting proper surveys for herpetofauna at least as an additional biodiversity element. We will look at critical urban habitats that are currently managed poorly and search for ideas and alternative land management choices. This discussion will include ideas on how Citizen Science can help define critical relictual habitats, and potential urban wildlife corridors by providing observational data and helping educate the general public on the importance of preserving habitats for each individual species within urban areas.

Predicting Non-Native Invasions and Native Persistence within Miami-Dade County's Herpetofaunal Community

Christopher A. Searcy, Stephanie L. Clements, and Caitlin C. Mothes

Department of Biology, University of Miami

South Florida has more established non-native herpetofaunal species than anywhere else in the world. This is most striking among lizards, with 29 of Miami-Dade County's 37 lizard species being of non-native origin. We are interested in this assemblage both in terms of what it can tell us about predicting herpetofaunal invasions in other parts of the globe and in terms of its impact on the few remaining native species. It is common practice to use ecological niche models to predict the potential of non-native species to become established, but such predictions are rarely verified. We are currently constructing niche models for each of the 29 non-native lizard species in Miami-Dade County. Concurrently, we are collecting physiological data on the critical thermal minima and maxima of the same species, as these are considered to be primary drivers of species range limits. We will test whether the thermal limits predicted by the niche models match the observed thermal limits in established populations. We are also conducting surveys of herpetofaunal diversity across a wide swath of Miami-Dade County's urban parks. This provides another opportunity to verify niche model predictions by comparing observed relative abundances of invasive species to relative habitat suitability scores generated by the niche models over the surveyed area. We are also using the survey data to determine whether certain types of parks support higher diversities and abundances of native species relative to invasive ones. In particular, we are interested in the effect of vegetation, since the native pine rockland habitat of Miami-Dade County has been reduced to 2% of its original extent. By surveying pairs of parks with native vs. non-native habitat, we will determine whether native species of herpetofauna occur more frequently and in higher abundances in the few fragments where the native pine rockland is preserved.

Does what we wear indirectly influence animals? A case study on the western fence lizard (*Sceloporus occidentalis*)

Bree Putman[1,2], Dan Blumstein[1], and Greg Pauly[2]

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Humans are often viewed as predators by animals, and can indirectly influence them through changes in activity budgets. Because changes in individual behavior can affect fitness, even small disturbances can significantly impact wildlife. In order to coexist with humans, animals could habituate to non-lethal disturbances by reducing responses over repeated encounters. Past studies have shown that animals are sensitive to nuanced aspects of human activity such as gaze direction, body posture, and even the noises of camera shutters. Thus, we sought to determine whether humans can also influence animal behavior though their choice of clothing color. Active wear is oftentimes brightly colored and can influence animals in natural areas, but animals living in an urban environment might be habituated to human activity and not be as affected. We examined the escape behaviors of western fence lizards (*Sceloporus occidentalis*) in response to four different colored t-shirts, taking into account potential perceptual biases towards their sexually-selected signaling color (blue) and habituation to humans in a tourist area. We performed flight initiation distance (FID) tests and quantified probability of capture after the FID trial (which associated with type of escape during the trial) in response to a dark blue, light blue, gray, and red t-shirt. We tested lizards at two sites that varied in human activity: a private nature reserve and a public park. We found no differences in lizard behavior between sites. However, lizards fled at longer distances when approached with a red shirt compared to dark blue, and they were least likely to be captured when approached with a red or gray shirt compared to blue. We show that humans can indirectly affect animal behavior based on their choice of clothing. These results have both conservation and methodological implications.

23. Invaders and survivors: Reptiles and amphibians in urban ecosystems

Detecting and Tracking Urban Invasives With Citizen Science

Gregory B. Pauly

Section of Herpetology and Urban Nature Research Center, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, CA 90007

Urbanization presents one of the world's greatest biodiversity threats. Not only is urbanization responsible for habitat modification, but the number of people and goods moving through urbanized areas also increases the chance of nonnative species being introduced. As a further complication, urbanized areas largely consist of private properties (*e.g.*, backyards) that are difficult for biologists to survey using standard methods. The challenge of surveying urbanized areas combined with the increased risk of species introductions could cause major lag times in detecting invasives. Citizen science, however, can provide an effective method for documenting the biodiversity of urban areas. The success of citizen science in documenting urban invasives is demonstrated by the Reptiles and Amphibians of Southern California (RASCals) citizen science project. Over five years, this project has led to discoveries of four new state records and 19 new county records of nonnative reptiles and amphibians. Some of these observations have resulted in citizen scientists and museum researchers co-authoring peer-reviewed, scientific publications. Importantly, these citizen science efforts have dramatically reduced detection times for invasive species and have rapidly generated data from urban settings that biologists otherwise could not access.

Winners and Losers in Urban Environments: Sonoran Desert Lizards

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Impacts of urbanization have been well-documented for amphibians and reptiles of the Southwest. In the Phoenix metropolitan area, wide ranging species such as Gila Monsters and Sonoran Desert Tortoises are now largely absent from all but the outlying areas. Relative to high density housing and urban settings, low density housing on the periphery maintains a higher diversity of reptiles, but it is unclear if these settings offer long-term opportunities for these wildlife. Remnant habitats maintained as mountain preserves have allowed some but not all reptile species originally present to persist. Surprisingly, at least one native reptile occurs over a larger area than it did historically, and a handful of exotic squamates have, with apparent anthropogenic assistance, recently colonized the Phoenix area. The complex interactions among biotic and abiotic factors, and anthropogenic impacts, reveal that the persistence of particular reptile species can only be predicted by understanding variation in species-specific natural history that can only be obtained by long-term study of individual taxa. I will review case studies of five lizard species for which historical data allow comparison with more recent systematic surveys conducted over the past 25 years. Shifts in distribution and abundance in relation to widespread development and the preservation of remnant habitats reveal that each form responds idiosyncratically on the basis of key ecological and behavioral tendencies.

23. Invaders and survivors: Reptiles and amphibians in urban ecosystems

Everyone Wants to Know, "Where Are the Rattlesnakes, and Are They A Problem?"

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Rattlesnakes are a characteristicpredator ofsoutheastern coastal ecosystems-wide knownand little understood. Although they are behaviorally docile species that poses little actual risk to people, their standing as the largest venomous snakesin North America generates a legitimate concern among residents, visitors, developers, land managers, and biologists about the potential for negative interactions with people. As a precautionary, yet short-sighted,measure to reduce safety risk to humans and domestic pets, it is typical that all encountered rattlesnakes are removed fromurbanareas. The most common question received when studying rattlesnake biology in developedareas is whether rattlesnakes arereally an issue for them, their children, or their pets. No one ever asks whether we are a problem for them. That latter question is our leading concern and the central focus in our long-term research oneastern diamondbacks (*Crotalus adamanteus*) and canebrake/timbers (*C. horridus*) in Georgia and South Carolina. Specifically, we aim to inform this dialogue and management procedure by quantifyingthe nature of co-existence of people and rattlesnakes in regards to which habitats they useandtheir proximate distribution relative to human activity. Our research employs radio telemetry to address thesewhere, when, and why components of our question. We also collect information on their microhabitat use and behaviors as measures of habitat quality and long-term viability. Lastly, our current research is further pursuing health parameters (vitamin levels, blood panels) and the presence of emerging disease, such as snake fungal disease. With referenceto specific results, we will present an overview on coastal rattlesnake ecology as it pertains to our imminent conservation concerns and as relevant for the short-and long-term management strategies that will be absolutely critical for persistence of these maligned predators in urban landscapes.

Cryptic Urban Biodiversity: The Atlantic Coast Leopard Frog

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We often consider our urban centers to be biodiversity deserts, largely or completely devoid of endangered or otherwise unknown species. Cities are the problem, not part of the solution, for conservation biology, and as a consequence most ecologists focus their attention on relatively pristine landscapes far removed from urban life. In 2012, we discovered a new species of leopard frog in urban New York City, which we described formally in 2014 as *Rana kauffeldi.* Since then, a multi-state team of field biologists have combed the eastern seaboard and discovered morphologically and acoustically recognizable populations of this previously unknown taxon from Connecticut to North Carolina; genetic analysis has confirmed virtually every siting. Although widely distributed geographically, *R. kauffeldi* is ecologically restricted to the coastal plain physiographic region, and its range boundary is almost perfectly coincident with that region's western boundary. This general area, which includes some of the most densely populated urban shoreline habitat in North America, emphasizes the importance that urban landscapes can have as refugia for rare and poorly studied wildlife, even in highly impacted landscapes.