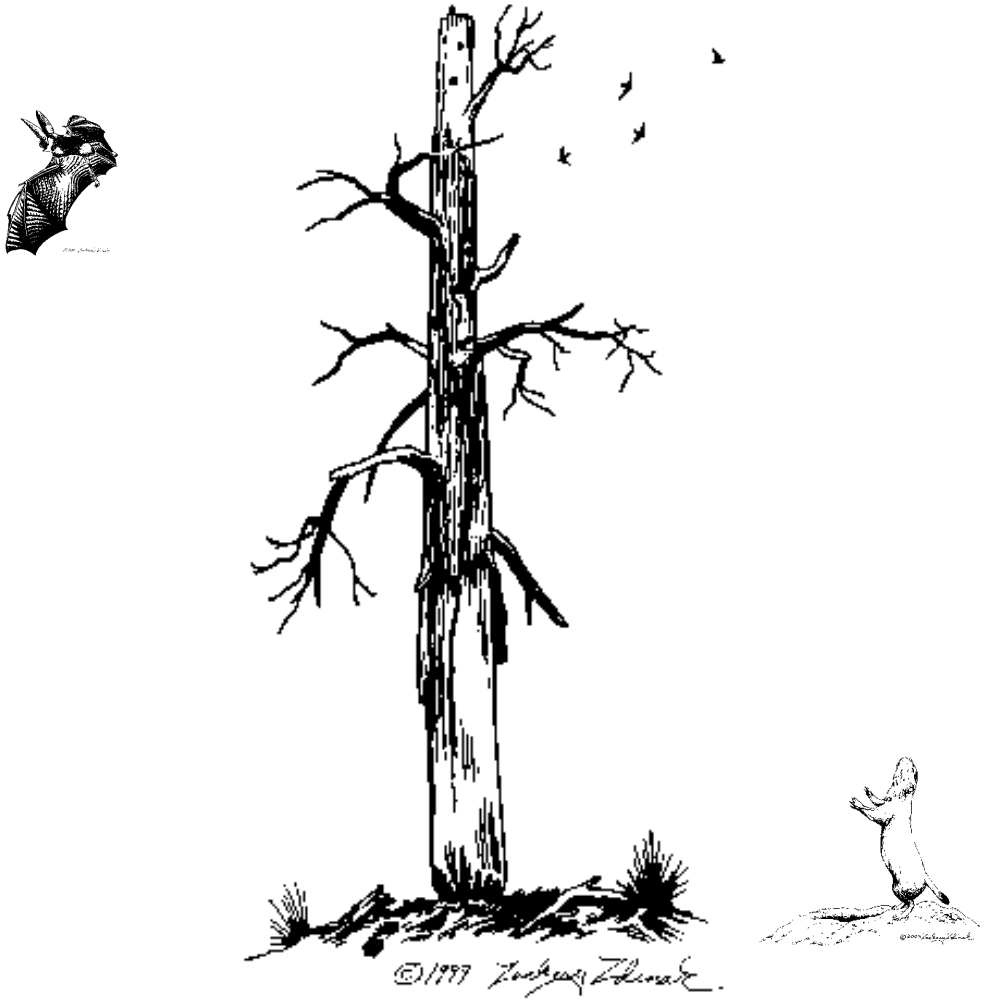
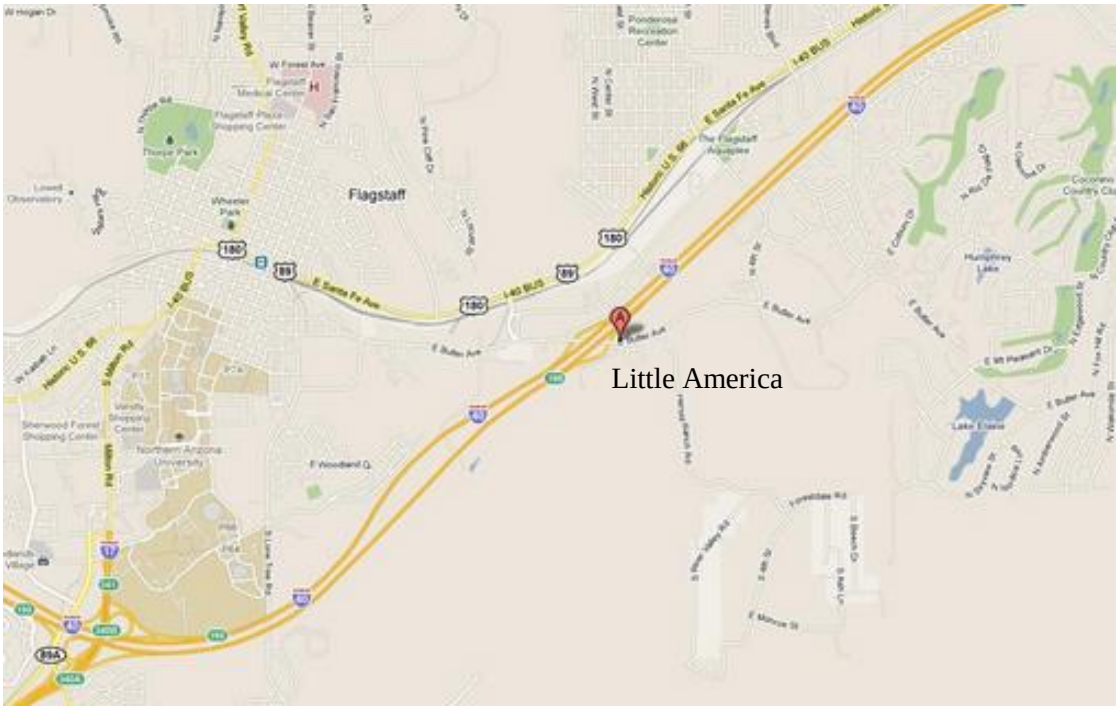
# 49th Joint Annual Meeting
# Arizona and New Mexico Chapters of
# The Wildlife Society
# And
# Arizona/New Mexico Chapter of
# The American Fisheries Society

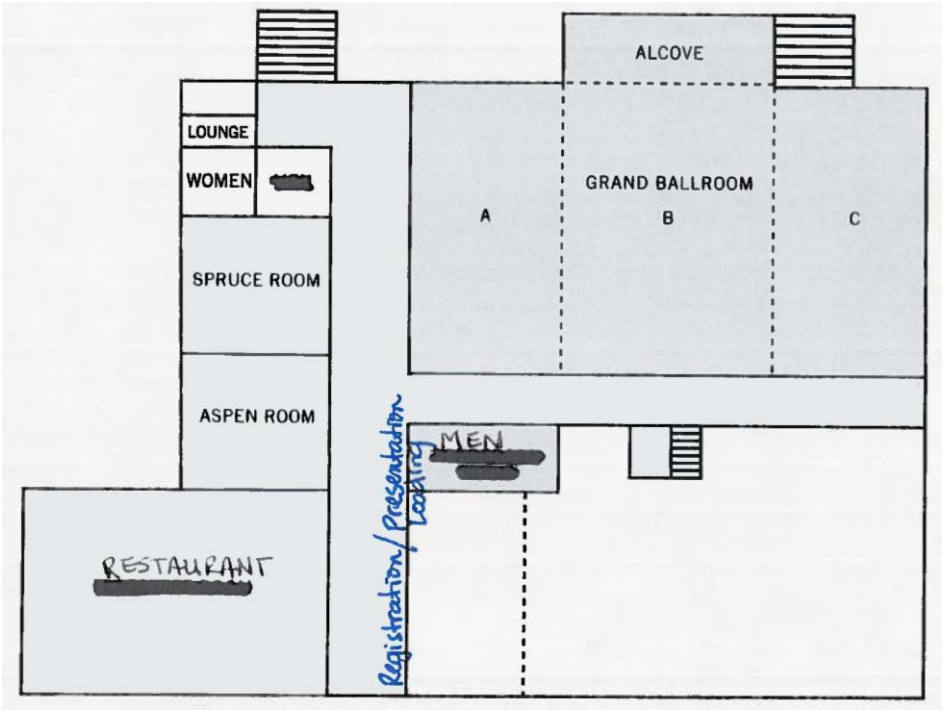
**February 4-6, 2016**
**Little America**
**Flagstaff, Arizona**



# Little America

**2515 E Butler Ave**
**Flagstaff, AZ 86004**
**(928) 779-7900**
**http://flagstaff.littleamerica.com/**



# 2016 List of Committee Chairpersons and Meeting Organizers

## Arizona Chapter of The Wildlife Society Executive Board

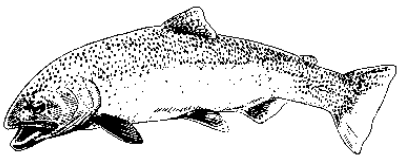
Melanie Culver, President, University of Arizona
Scott Sprague, President-Elect, Arizona Game and Fish Department
Dana Warnecke, Treasurer, Arizona Game and Fish Department
Ryan Revells, Corresponding Secretary, US Bureau of Reclamation
Kay Nicholson, Recording Secretary, Logan Simpson
Holly Hicks, Board Member, Arizona Game and Fish Department
Tiffany Sprague, Board Member, Arizona State University

| | |
|---|---|
| **2016 Annual Meeting Chair**: | Melanie Culver, University of Arizona |
| **Program Committee** | |
| Plenary Session: | Jon Hanna, Arizona Game and Fish Department, Retired |
| Technical/Poster Sessions: | Scott Sprague, Arizona Game and Fish Department (Wildlife)<br>Melanie Culver, University of Arizona (Wildlife)<br>John Caldwell, New Mexico Department of Game and Fish (Fisheries) |
| Student Awards: | Melanie Bucci, University of Arizona |
| Program Layout: | Kay Nicholson, Logan Simpson |
| **Facility Arrangements** | Melanie Culver, University of Arizona |
| **Announcements** | Audrey Owens, Arizona Game and Fish Department |
| **Registration** | Dana Warnecke, Arizona Game and Fish Department |
| **Audio-Visual** | Chase Voirin, University of Arizona |
| **Raffle and Silent Auction** | Sarah Rinkevich, US Fish and Wildlife Service |
| **Quiz Bowl** | Brett Montgomery, Utah Division of Wildlife Resources |
| **Student Volunteer Coordinator** | Holly Hicks, Arizona Game and Fish Department |
| **Photo Contest/Art Display** | Christina Kondrat-Smith, Arizona Game and Fish Department |
| **Job and Message Board** | Ryan Revells, US Bureau of Reclamation |
| **Vendor Arrangements** | Natalie Robb, Arizona Game and Fish Department |

# Schedule at-a-Glance

| Start | End | Event | Location |
|---|---|---|---|
| **ASSOCIATED MEEETINGS** | | | |
| **Wednesday February 3** | | | |
| 8:00 a.m. | 5:00 p.m. | Intermountain West Joint Venture State Conservation Partnership | Aspen |
| **Thursday February 4** | | | |
| 1:00 p.m. | 3:00 p.m. | Bat Working Group Meeting | Ballroom B |
| **WOKSHOP SCHEDULE** | | | |
| **Thursday February 4** | | | |
| 9:00 a.m. | 4:00 p.m. | Piscicide Training | Ballroom A |
| 8:00 a.m. | 12:00 p.m. | Interview and Resume Building Workshop | Ballroom C |
| 8:00 a.m. | 12:00 p.m. | Becoming a Compelling Communicator for Conservation | Spruce |
| 8:00 a.m. | 12:00 p.m. | New Technologies in Wildlife/Fisheries Management: Apps | Aspen |
| 8:00 a.m. | 12:00 p.m. | Incorporating Climate Change Data | AGFD Offices, Flagstaff |
| 12:00 p.m. | 1:00 p.m. | Lunch | On Your Own |
| 1:00 p.m. | 4:00 p.m. | Interview and Resume Building: Mock Interview Workshop | Ballroom C |
| 1:00 p.m. | 4:00 p.m. | Wildlife Conservation Legislation and Advocacy | Spruce |
| 1:00 p.m. | 4:00 p.m. | New Technologies in Wildlife/Fisheries Management: Drones | Aspen |
| 1:00 p.m. | 4:00 p.m. | Venomous Reptile Handling | AGFD Offices, Flagstaff |
| **JAM MEEETING SCHEDULE** | | | |
| **Thursday February 4** | | | |
| 12:00 p.m. | 6:00 p.m. | Registration | Hallway |
| 3:00 p.m. | 6:30 p.m. | Presentation Loading | Hallway |
| 3:00 p.m. | 6:00 p.m. | Poster/Photo Set-up | Foyer |
| 4:30 p.m. | 6:00 p.m. | AZ TWS Business Meeting | Ballroom A |

| | | | |
|---|---|---|---|
| 4:30 p.m. | 6:00 p.m. | NM TWS Business Meeting | Aspen |
| 4:30 p.m. | 6:00 p.m. | AZ/NM AFS Business Meeting | Spruce |
| 5:00 p.m. | | Raffle and Silent Auction Open | Ballroom B |
| 6:00 p.m. | 9:00 p.m. | Welcome Social and Appetizers | Ballroom B |
| 7:00 p.m. | 9:00 p.m. | Student Quiz Bowl | Ballroom C |
| **Friday February 5** | | | |
| 7:00 a.m. | 2:00 p.m. | Registration | Hallway |
| 7:00 a.m. | 11:00 a.m. | Presentation loading | Hallway |
| 6:30 a.m. | 7:45 a.m. | SW Section Breakfast-open to all attendees, tickets-SW chapter table | Aspen |
| 10:00 a.m. | | Deadline to Submit for Photo Contest | Conference Registration |
| 8:00 a.m. | 11:30 a.m. | Plenary Session | Grand Ballroom |
| 9:30 a.m. | 9:45 a.m. | Morning Coffee Break | Hallway |
| 11:30 a.m. | 1:00 p.m. | Lunch | On your own |
| 11:30 a.m. | 1:00 p.m. | Student Mentor Lunch | Aspen |
| 12:00 p.m. | 5:00 p.m. | Photo Contest Voting Open | Foyer |
| 1:00 p.m. | 3:00 p.m. | Concurrent Technical Sessions | Ballrooms A, B, C, Spruce |
| 3:00 p.m. | 3:20 p.m. | Afternoon Snack | Hallway |
| 3:20 p.m. | 5:20 p.m. | Concurrent Technical Sessions | Ballrooms A, B, C, Spruce |
| 4:00 p.m. | 5:30 p.m. | Presentation loading | Hallway |
| 4:30 p.m. | 6:30 p.m. | Poster Session Social | Foyer |
| 5:30 p.m. | | Raffle and Silent Auction Close | Ballroom B |
| 7:00 p.m. | 9:30 p.m. | Banquet and Awards Ceremony | Grand Ballroom |
| 7:00 p.m. | 9:30 p.m. | Poster/Photo Take Down | |
| **Saturday February 6** | | | |
| 7:00 a.m. | 8:00 a.m. | AFS/TWS Officers Breakfast (reservation under M. Culver) | Little America Restaurant |
| 8:00 a.m. | 12:40 p.m. | Concurrent Technical Sessions | Ballrooms A, B, C, Spruce |
| 10:00 a.m. | 10:20 a.m. | Morning Coffee Break | Hallway |
| 10:20 a.m. | 1:00 p.m. | Concurrent Technical Sessions | Ballrooms A, B, C, Spruce |



# Who Will Manage the Future of Our Public Lands

## Plenary Session Speakers:

**Brenda Barton – Republican, District 5, House of Representatives**
Born in Safford, Arizona, Representative Barton is a fifth generation native of rural eastern Arizona. By the mid-1990s, public events drew her into political activism and she became an elected officer of People for the West, a land rights group. Representative Barton is a veteran of the Sage-Brush Rebellion that swept the Western Lands States from the 1970s into the 1990s. Her top issues are building a strong state economy coupled with the conservation of our quality of life in Arizona. She is the chairperson for House Bill 2658 that established the Transfer of Federal Lands Study Committee and also the Chairman of Agriculture, Water and Lands Committee.

**Lisa Atkins – Commissioner of the Arizona State Land Department**
As an Arizona native, Lisa combines a well-rounded understanding of the State with more than 40 years of work in the federal and State legislative and policy arenas. While serving for more than twenty-three years as Chief of Staff to Congressman Bob Stump (R-AZ), Lisa worked closely with residents, citizens' groups, associations and State and local governments on a wide and diverse set of issues of importance to Arizona, particularly focusing on land, water and military issues. After her tenure with Congressman Stump, Lisa served as the Executive Director of the County Supervisors Association of Arizona (CSA), representing the elected County Supervisors in Arizona on policy and budget matters. Prior to joining the Governor's Administration in June 2015, Lisa served for eleven years as the Vice President for Public Policy for Greater Phoenix Leadership (GPL), a group of the Region's top business and industry leaders. Lisa is well respected in the Arizona community for her involvement in a variety of organizations. Among her current community activities, Lisa represents Maricopa County as an elected member of the Board of the Central Arizona Water Conservation District, which is responsible for operating, maintaining, repaying and managing the Central Arizona Project. She also serves as an advisory member of the statewide Governor's Military Affairs Commission, which is the permanent body to monitor and make recommendations to the Governor and Legislature on executive, legislative and federal actions necessary to sustain and grow Arizona's network of military installations, training and testing ranges, and associated airspace. She served as the Co-Chair of the Commission from its inception in 2004 until assuming her role as State Land Commissioner.Mrs. Atkins graduated from the University of Arizona. Lisa and her husband John live in Phoenix.

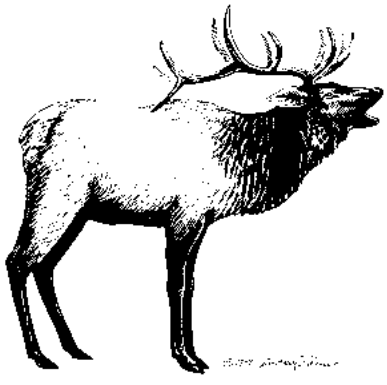
**Mandy Metzger – Coconino County and president-elect of the Arizona County Supervisors Association**
Mandy Metzger was elected this year by her Arizona colleagues as President of the County Supervisors Association (CSA). Supervisor Metzger will lead the organization's executive board for 2016, helping to develop plans and implement strategies for strengthening Arizona counties in state policymaking. Supervisor Metzger Chairs the Coconino Plateau Water Advisory Council and was appointed by Department of Interior Secretary Sally Jewell to the Bureau of Land Management Resource Advisory Committee. "I firmly believe that by forging strong partnerships with elected officials at all levels of government, we can work together to find solutions to strengthen service to our constituents." Mandy served as natural resource and public lands policy advisor for a former United States Senator in Washington D.C. Her family has ranched in Northern Arizona since the late 1800's.

**Steve Hattenbach – Regional Director, Rangeland Management & Acting Regional Director, Wildlife, Fish & Rare Plants USDA Forest Service Southwestern Region**
Mr. Hattenbach has worked in the Southwest since 1997, on a wide variety of environmental and natural resource issues. He holds an undergraduate in Anthropology and History, a Master of Public Administration with a concentration in Natural Resource Management, and a Juris Doctorate. His past experience includes 18 years of legal counsel for State local and Federal governments involving environmental and natural resource issues, and several management positions with the US Forest Service Southwestern Region. He is currently the Regional Director for Rangeland Management and Wildlife Management for the Southwestern Region, which spans Arizona, New Mexico, Oklahoma, and Texas, and which manages over 20 million acres of National; Forest System lands on 11 National Forests and 3 National Grasslands.

**Cyndi Tuell – Attorney at Law and Southwest Conservation Advocate**
Cyndi Tuell has worked as an attorney and passionate conservation advocate since September 2007, focusing on federal public lands management issues in New Mexico and Arizona. Ms. Tuell works with national and local conservation partners in both states to protect the habitat of native species and ensure good land management policies are implemented to protect natural resources and quiet recreation opportunities. Ms. Tuell holds a bachelor of science in Ecology and Evolutionary Biology and a law degree from the University of Arizona James E. Rogers College of Law. While in law school, Ms. Tuell worked for the Sonoran Institute researching conservation issues related to State Trust Lands and co-authored two publications on State Trust Lands in the West. Since October 2013, Ms. Tuell has been working as a consultant to various non-profit conservation organizations with an emphasis on borderlands natural resource protection.

**Todd Leahy – Director of Conservation, New Mexico Wildlife Federation**
Todd has lived all over the country, but learned to hunt and fish at an early age. He attended Oklahoma State University, and earned a doctorate in American Indian history. As a teacher, his research focused on conflicts about land and resource rights, ownership and use. A desire to advocate on these issues led him to law school and a degree in Land Use and Environmental law, which he put into practice while working for the Missouri Department of Natural Resources. Todd has hiked and camped much of the American West. Normally a rifleman, Todd is currently trying his hand at bow hunting. He also enjoys fishing and is excited for the day he can introduce his infant son to the rivers of the Southwest.

**Jennifer Fielder – Montana State Senator and American Lands Council Representative**
Jennifer's decision to step forward to serve in the State Legislature in 2012 was rooted in prayer and a deep reverence for the principles of life, liberty, and property which made this nation great. Jennifer believes it's not too late to get America back on the right track, but it will only happen if enough good people become informed and active in government processes. Her professional experience includes extensive work in both the public and private sectors - providing her with valuable insights from both perspectives. Jennifer is married to Paul, a retired wildlife biologist and active outdoors man. They live near Thompson Falls, MT where they enjoy living close to the land -- gardening, fire wooding, hunting, fishing, trapping, and managing their timber land for optimal forest health and wildlife habitat.



| Fri Feb 5 | Fisheries Session 1 | Fisheries Session 2 (Student Session) | Wildlife Session 1 (Student Competition) | Wildlife Session 2 |
|---|---|---|---|---|
| | Laurence D'Alessandro | Eric Frey | Kay Nicholson | Virginia Seamster |
| **Room** | Ballroom A | Ballroom B | Ballroom C | Spruce |
| 1:00 | Can we determine age and growth of warmwater fish in a coldwater river? **Pilar Wolters** | Retrospective food web analysis of the Gila River: Do native and non-native interactions intensify during drought? **Rosalee A Reese*** | Next-generation sequencing vs. Microhistology: Investigating Diet Composition Variables of Mule Deer Populations on the Navajo Nation-**Chase Voirin*** | Restoring composition and structure in southwestern frequent-fire forests: a science-based framework for improving ecosystem resiliency **James Youtz** |
| 1:20 | Nonnative trout removal in a tributary stream: does it benefit native fish in the mainstem Colorado River? **David L Rogowski** | Relationship between AFS standard fish sampling techniques and environmental DNA (eDNA) for characterizing fish relative abundance, biomas, and species composition in Arizona standing waters **Christina R. Perez*** | Use of Conservation Reserve Program (CRP) habitat by lesser prairie-chicken in eastern New Mexico-**Andrew R. Meyers*** | Transient connectivity windows: Impacts of temporary and permanent isolated water resources in the Sonoran Desert on connectivity, isolation, and wildlife management strategies **Joseph Drake*** |
| 1:40 | Flannelmouth Sucker distribution, movement and growth within the Colorado River, Arizona **Robin J. Osterhoudt** | Reproductive Potential of Wild Rio Grande Silvery Minnow (Hybognathus amarus) **Hunter Falco*** | Evaluating the complex and dynamic facilitative effects of tamarisk obligate insects for two native riparian warblers. **Sean Mahoney*** | Can incentives help overcome landowner concerns about conserving endangered species on their land? A rancher case study about jaguar critical habitat and rangeland conservation **Colleen Svancara** |
| 2:00 | Current status of small-bodied fishes in the San Juan River, New Mexico and Utah **Matthew P. Zeigler** | Effects of Tagging with Passive Integrated Transponders versus Visual Elastomer Implants on the Small-bodied White Sands Pupfish (Cyprinodon tularosa) **Damon M. Peterson*** | Does a Bear Live in the Woods? A Study of Urban Black Bears in Northern New Mexico-**Casey Taylor*** | Modeling patch occupancy to examine competition between energy development and wildlife. **Bill Dunn** |

| Room | Ballroom A | Ballroom B | Ballroom C | Spruce |
|---|---|---|---|---|
| 2:20 | Pecos Pupfish conservation and mangement in New Mexico **John M. Caldwell** | CFT Legumine™ (5% rotenone) Effects on Tadpole Survival and Metamorphosis of Chiricahua Leopard Frog (Lithobates chiricahuensis), Northern Leopard Frog (L. pipiens), and American Bullfrog (L. catesbeianus) **Guillermo Alvarez*** | Estimating density of American black bears in New Mexico using noninvasive genetic sampling-based spatial capture-recapture methods-**Matthew J. Gould*** | Update on wildlife issues in review of renewable energy development projects and transmission lines and energy market based trends in project design and siting. **William Werner** |
| 2:40 | Refuge populations of White Sands Pupfish diverge in the absence of high gene flow **Sandra Bohn** | Asian Tapeworm in an Endangered Southwestern Fish: Assessing Infections Using a Non-lethal Molecular Screening Tool **Meredith C. Campbell*** | Resuming a keystone role: the return of black-tailed prairie dogs to Arizona-**Sarah L. Hale*** | On Overview of the Sovereign Citizen Movement: Keeping You Safe in the Field. **Jon Hanna** |
| **3:00-3:20 BREAK** | | | | |
| **Fri Feb 5** | **Fisheries Session 3** | **Wildlife Session 3** | **Wildlife Session 4** | **Wildlife Session 5 (Military Lands)** |
| | David Stewart | Lindsay Smythe | Bill Burger | Janet Johnson |
| 3:20 | Use of ultrasonic imaging to evaluate egg maturation of humpback chub Gila cypha in the Grand Canyon **Morgan E. Brizendine*** | PumaPlex100: An improved tool for the genetic analysis of pumas. **Alex Erwin*** | Presence-only modelling reveals potential major shifts in suitable climatic niches for Western North American bats **Dan Taylor** | Flat-tailed Horned Lizard Demographic Monitoring in the Yuma Desert Management Area (2008-2015), Arizona **Ashley Grimsley** |
| 3:40 | Wildfire effects on genetic diversity and recolonization of longfin dace, Agosia chrysogaster **Tyler J. Pilger** | Functional genomics of the endangered Florida panther **Alex Ochoa*** | Once upon a time in Mexico: prehistoric habitat suitability of the spotted bat **Daniel Sanchez** | Using Non-invaisive sampling methods to reduce human-wildlife interactions on Camp Navajo, an Arizona Army National Guard Installation. **Hannah Telle** |

| Room | Ballroom A | Ballroom B | Ballroom C | Spruce |
|---|---|---|---|---|
| 4:00 | The contribution of the Gila River Native Fishes Recovery Program (GRBNFCP/CAP) to the recovery of native aquatic species **Douglas K. Duncan** | Influence of Natural and Anthropogenic Disturbances on Multi-Scale Black Bear Habitat Selection **Susan Bard*** | A Review of Echolocation Detection Studies **Clarissa Starbuck*** | Evaluating bat use on the Barry M. Goldwater Range East **Joel Diamond** |
| 4:20 | Repatriation of Gila Chub into Mule Creek, New Mexico **Andrew M. Monié** | Cross-fostering: a novel tool for Mexican wolf recovery **Julia Smith** | Does a gate's design or length of time installed affect bat use and behavior at abandoned mines in western U.S.? **Abigail Tobin*** | Combining non-invasive fecal sampling of genetics and physiology: how does considering individual effects influence results? **Dave Christianson** |
| 4:40 | Evaluation of current versus alternative sampling methods of Rio Yaqui fishes using gee funnel minnow traps **David R. Stewart** | Towards an increased understanding of space use and poaching risk in rhinos: vegetation mapping in the lowveld of South Africa **Melissa Merrick*** | Beyond the bat – bats as drivers of bacterial biodiversity in abandoned mines of Arizona, New Mexico, and Utah. **Viacheslav Fofanov** | Response in Songbird Abundance to Forest Treatments on Camp Navajo, Arizona. **Russell Gwinn** |
| 5:00 | Improving ESA Implementation: The Species Status Assessment framework **Mike Martinez** | Characterization of epigenetic variation in endangered Sonoran pronghorn, *Antilocapra americana sonoriensis* . **Melanie Culver** | Investigating Bat Actinobacterial Microbiota and Natural Defenses against White-nose Syndrome **Debbie Buecher** | Monitoring of Sonoran Desert Tortoises on DOD facilities in Arizona **Daniel Leavitt** |
| 5:20 | Spikedace and loach minnow mesohabitat use in repatriated streams in Arizona **Kent R. Mosher** | Assessing translocated pronghorn adult and fawn survival in Fort Stanton, New Mexico **Emily Conant** | Upping the ante: bat species identification from gobs of guano **Colin Sobek** | Response of forest dwelling bats to forest management treatments on Campo Navajo **Joel Diamond** |

| Room | Ballroom A | Ballroom B | Ballroom C | Spruce |
|---|---|---|---|---|
| **Sat Feb 6** | **Fisheries Session 4** | **Wildlife Session 6** | **Wildlife Session 7** | **Wildlife Session 8** |
| | Eric Frey | Stanley Cunningham | Dan Taylor | Anika Keeley |
| 8:00 | Effect of length-based harvest regulations for trophy and recreational Ictalurus fisheries **David R. Stewart** | Plagued by epidemics: how cats, woodrats and human debris make the case for a one health approach in Arizona **Erin Nigon** | A method for assessing presence of the endangered New Mexico meadow jumping mouse **Rachel Harrow*** | Too dry for lizards: rainfall influence on lizard microhabitat use in an experimental rainfall manipulation within a piñon-juniper **Mason Ryan** |
| 8:20 | Assessment of time-lapse trail cameras to monitor angler use on Arizona lakes and streams **Kristopher J. Stahr** | Home on the range: radiotelemetric assessment of home ranges in antelope jackrabbits for the first time **Maria Altemus*** | Wolves of the rodent world: Species differences in grasshopper mouse howls and prospects for automated monitoring of an indicator species **Bret Pasch** | Evaluating the effectiveness of citizen science in aiding the conservation of two declining gartersnake species in the Verde River Watershed, Arizona **Noelle Fletcher*** |
| 8:40 | Evaluating effectiveness of side-scan sonar in assessing littoral habitat diversity in reservoirs **Amberle K. Jones** | Relatedness of the Tamaulipas jackrabbit (Lepus altamirae): The case of Mexico's missing white-sided jackrabbit **Wisely and Vargas** | The diverse world of New Mexico meadow jumping mouse **Carol Chambers** | Native and nonnative prey availability and diet of northern Mexican gartersnakes in north-central Arizona **Iain Emmons*** |
| 9:00 | Two case findings: Possible Loma salmonae in yearling apache trout at Silver Creek hatchery and the identification of a highly pathogenic form of Saprolegnia infecting and killing rainbow trout and apache trout at Tonto Creek hatchery **Joe Marcino** | Climate effects in the cache behavior of the Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis* ) **Calebe Mendes*** | Detection rates during surveys of the endangered New Mexico meadow jumping mouse **Ian Perkins-Taylor*** | Microhabitat evaluation for northern Mexican gartersnakes at Bubbling Pond Hatchery **Tiffany Sprague*** |

| Room | Ballroom A | Ballroom B | Ballroom C | Spruce |
|---|---|---|---|---|
| 9:20 | The Fate of Stocked Trout in Arizona Streams **Ryan Mann** | Habitat use of the San Bernardino flying squirrel in a post fire landscape **Maxwell Mazella*** | Effects of ambient light on puma, deer, and elk activity **Scarlet Sellers*** | Current and future landscape-level suitability models for two species of gartersnakes from Arizona and New Mexico and their implications for management. **Tom Giermakowski** |
| 9:40 | Weight counts in aquaculture: Debunking some myths. **Ethan B. Mower** | Genetic and Phenotypic Variation Among Fox Squirrels in Eastern North Carolina **Kendell Bennett*** | Top-Down and Bottom-Up Forces on Central New Mexico Mule Deer **Jacob Kay*** | Demography of canyon treefrogs in desert mountain canyons **Erin Zylstra*** |
| **10:00-10:20 BREAK** | | | | |
| **Sat Feb 6** | **Fisheries Session 5 and WOW** | **Wildlife Session 9** | **Wildlife Session 10** | **Wildlife Session 11** |
| | Carol Chambers | Charles Dixon | Roger Joos | Gary Roemer |
| 10:20 | Effect of Enrichment in the Hatchery on the Performance of Brook Trout and Atlantic Salmon **Bryan D. Ferguson** | Spatially explicit models of peripheral squirrel populations inform management of both invasive and endangered species **Emily Goldstein** | Preliminary Sightability Model Development for Arizona Elk Populations **Kirby Bristow** | Multiscale analysis of Mexican spotted owl breeding site selectivity vs adjusted reproduction indexes (ARPI) **Serra Hoagland*** |
| 10:40 | Mechanical removal of Green Sunfish (Lepomis cyanellus) in East Ash Creek, Bill Williams Drainage. **David Partridge** | Variable interactions between tree squirrel species in areas of natural and anthropogenic overlap **Jonathan Derbridge*** | Animal migration altered by cheatgrass and concomitant shifts of fire and phenology: The Kaibab mule deer example **Richard Lucas** | Evaluating Desired Conditions for Mexican Spotted Owl Nesting and Roosting Habitat **Jeff Ganey** |

| Room | Ballroom A | Ballroom B | Ballroom C | Spruce |
|---|---|---|---|---|
| 11:00 | The Resilience of Sea Turtles to Climate Change through a Quantitative Framework **Nichole Engelmann** | What Everyone Wants to Know About Permits! **Christina Kondrat-Smith** | Effects of non-motorized recreation on mid-size and large mammals in the San Francisco Bay area **Michelle Reilly*** | First- through fourth-year dispersal of golden eagles from natal areas in the Colorado Plateau Region of the Southwestern United States **Robert Murphy** |
| 11:20 | Ground-Based Thermal Imaging of Stream Surface Temperatures: Technique and Evaluation **Scott A. Bonar** | Habitat suitability model of American hog-nosed skunk in Grand Canyon National Park. **Lance T. Murray*** | An Evaluation of Off-Highway Vehicle Influence on Space Use by Kit Foxes in Arizona. **Andrew Jones** | Available data support protection of the Southwestern Willow Flycatcher under the Endangered Species Act **Tad Theimer** |
| 11:40 | Comparison of AFS standard snorkeling techniques to eDNA sampling techniques **Roy M. Ulibarri*** | Isotopic evidence links drought stress and bottom-up regulation in a grassland herbivore **Chuck Hayes** | Conserving Nature's Stage **Paul Beier** | Evaluating the use of PIT tags and satellite transmitters to model the survival and movements of Band-tailed Pigeons in New Mexico **Chris Coxen** |
| 12:00 | Women of Wildlife (WOW), 12:00 - 1:00, Panel Discussion.**Kathy Granillo, Kay Nicholson, Serra Hoagland** | Pre-dispersal exploratory movements - and implications for dispersal in fragmented landscapes. **Annika Keeley** | Natural resource applications of the phenology data and information housed in the National Phenology Database **Erin Posthumus** | Population genetic diversity and structuring in yellow-billed cuckoos **Shannon McNeil*** |
| 12:20 | WOW Panel - continued | AgDiscovery Programs at Virginia State University and University of Hawaii at Manoa **Meagan vanPelt*** | Using citizen science to monitor avian communities in the Arizona Sky Islands **Jamie Sanderlin** | Spatial ecology of the Lower Colorado River Valley population of greater sandhill cranes **Courtnay Corning*** |
| 12:40 | WOW Panel - continued | | | |

# Plenary Session

## *"Who Will Manage the Future of Our Public Lands"*

***Grand Ballroom***

| | |
|---|---|
| 8:00 – 8:10 a.m. | Welcome and Opening Remarks, CAROL CHAMBERS, Northern Arizona University |
| 8:10 – 8:30 a.m. | BRENDA BARTON, Republican, District 5, House of Representatives |
| 8:30 – 8:50 a.m. | LISA ATKINS, Commissioner of the Arizona State Land Department |
| 8:50 – 9:10 a.m. | MANDY METZGER, Coconino County and president-elect of the Arizona County Supervisors Association |
| 9:10 – 9:30 a.m. | STEVE HATTENBACH, Regional Director, Rangeland Management USDA Forest Service Southwestern Region |
| 9:30 – 9:45 a.m. | Break |
| 9:45 – 10:05 a.m. | CYNDI TUELL, Attorney at Law and Southwest Conservation Advocate |
| 10:05 – 10:25 a.m. | TODD LEAHY, Director of Conservation, New Mexico Wildlife Federation |
| 10:25 – 10:45 a.m. | JENNIFER FIELDER, Montana State Senator and American Lands Council Representative |
| 10:45 – 11:30 a.m. | Panel Discussion |
| 11:30 – 1:00 p.m. | Lunch |

# Concurrent Technical Sessions

## Fisheries Session 1

***Ballroom A***

1:00 p.m. 1 **Can we determine age and growth of warmwater fish in a coldwater river?**
PILAR WOLTERS

1:20 p.m. 2 **Nonnative trout removal in a tributary stream: does it benefit native fish in the mainstem Colorado River?**
DAVID L. ROGOWSKI

1:40 p.m. 3 **Flannelmouth Sucker distribution, movement and growth within the Colorado River, Arizona**
ROBIN J. OSTERHOUDT

2:00 p.m. 4 **Current status of small-bodied fishes in the San Juan River, New Mexico and Utah**
MATTHEW P. ZEIGLER

2:20 p.m. 5 **Pecos Pupfish conservation and mangement in New Mexico**
JOHN M. CALDWELL

2:40 p.m. 6 **Refuge populations of White Sands Pupfish diverge in the absence of high gene flow**
SANDRA BOHN

3:00 p.m. Break (20 minutes)

## Fisheries Session 2 (Student Session)

***Ballroom B***

1:00 p.m. 7 **Retrospective food web analysis of the Gila River: Do native and non-native interactions intensify during drought?**
*** ROSALEE A. REESE

1:20 p.m. 8 **Relationship between AFS standard fish sampling techniques and environmental DNA (eDNA) for characterizing fish relative abundance, biomas, and species composition in Arizona standing waters**
*** CHRISTINA R. PEREZ

1:40 p.m. 9 **Reproductive Potential of Wild Rio Grande Silvery Minnow (*Hybognathus amarus*)**
*** HUNTER FALCO

2:00 p.m. 10 **Effects of Tagging with Passive Integrated Transponders versus Visual Elastomer Implants on the Small-bodied White Sands Pupfish (*Cyprinodon tularosa*)**
*** DAMON M. PETERSON

2:20 p.m. 11 **CFT Legumine™ (5% rotenone) Effects on Tadpole Survival and Metamorphosis of Chiricahua Leopard Frog (*Lithobates chiricahuensis*), Northern Leopard Frog (*L. pipiens*), and American Bullfrog (*L. catesbeianus*)**
*** GUILLERMO ALVAREZ

2:40 p.m. 12 **Asian Tapeworm in an Endangered Southwestern Fish: Assessing Infections Using a Non-lethal Molecular Screening Tool**
*** MEREDITH C. CAMPBELL

3:00 p.m. Break (20 minutes)

## Wildlife Session 1 (Student Competition)

***Ballroom C***

1:00 p.m. 13 **Next-generation sequencing vs. Microhistology: Investigating Diet Composition Variables of Mule Deer Populations on the Navajo Nation**
*** CHASE VOIRIN and Melanie Culver

1:20 p.m. 14 **Use of Conservation Reserve Program (CRP) habitat by lesser prairie-chicken in eastern New Mexico**
*** ANDREW R. MEYERS, Scott A. Carleton, and William R. Gould

1:40 p.m. 15 **Evaluating the complex and dynamic facilitative effects of tamarisk obligate insects for two native riparian warblers**
*** SEAN MAHONEY, Tad C. Theimer, and Matthew J. Johnson

2:00 p.m. 16 **Does a Bear Live in the Woods? A Study of Urban Black Bears in Northern New Mexico**
*** CASEY TAYLOR, Sarah Corey-Rivas, and Jesus Rivas

2:20 p.m. 17 **Estimating density of American black bears in New Mexico using noninvasive genetic sampling-based spatial capture-recapture methods**
*** MATTHEW J. GOULD, James W. Cain III, Gary W. Roemer, William R. Gould, and Stewart G. Liley

2:40 p.m. 18 **Resuming a keystone role: the return of black-tailed prairie dogs to Arizona**
*** SARAH L. HALE, John L. Koprowski, and Steven R. Archer

3:00 p.m. Break (20 minutes)

## Wildlife Session 2

***Spruce***

1:00 p.m. 19 **Restoring composition and structure in southwestern frequent-fire forests: a science-based framework for improving ecosystem resiliency**
Reynolds, Richard T., Andrew J. Sánchez Meador, JAMES YOUTZ, Tessa Nicolet4, Megan S. Matonis1,5, Patrick L. Jackson3, Donald G. DeLorenzo3, and Andrew D. Graves

1:20 p.m. 20 **Transient connectivity windows: Impacts of temporary and permanent isolated water resources in the Sonoran Desert on connectivity, isolation, and wildlife management strategies**
McIntyre, Nancy. E.1, *** DRAKE, JOSEPH2 (Graduate), and Kerry L. Griffis-Kyle

1:40 p.m. 21 **Can incentives help overcome landowner concerns about conserving endangered species on their land? A rancher case study about jaguar critical habitat and rangeland conservation**
COLLEEN SVANCARA, Aaron M. Lien, Wendy T. Vanasco, Scott A. Bonar4, George B. Ruyle, and Laura López-Hoffman

2:00 p.m. 22 **Modeling patch occupancy to examine competition between energy development and wildlife**
BILL DUNN and Bruce T. Milne

2:20 p.m. 23 **Update on wildlife issues in review of renewable energy development projects and transmission lines and energy market based trends in project design and siting**
WILLIAM WERNER

2:40 p.m. 24 **On Overview of the Sovereign Citizen Movement: Keeping You Safe in the Field**
JON HANNA

3:00 p.m. Break (20 minutes)

## Fisheries Session 3

***Ballroom A***

3:20 p.m. 25 **Use of ultrasonic imaging to evaluate egg maturation of humpback chub Gila cypha in the Grand Canyon**
*** MORGAN E. BRIZENDINE

3:40 p.m. 26 **Wildfire effects on genetic diversity and recolonization of longfin dace, Agosia chrysogaster**
TYLER J. PILGER

4:00 p.m. 27 **The contribution of the Gila River Native Fishes Recovery Program (GRBNFCP/CAP) to the recovery of native aquatic species**
DOUGLAS DUNCAN

4:20 p.m. 28 **Repatriation of Gila Chub into Mule Creek, New Mexico**
ANDREW M. MONIÉ

4:40 p.m. 29 **Evaluation of current versus alternative sampling methods of Rio Yaqui fishes using gee funnel minnow traps**
DAVID R. STEWART

5:00 p.m. 30 **Improving ESA Implementation: The Species Status Assessment framework**
MIKE MARTINEZ

5:20 p.m. 31 **spikedace and loach minnow mesohabitat use in repatriated streams in Arizona**
KENT R. MOSHER

## Wildlife Session 3
***Ballroom B***

3:20 p.m. 32 **PumaPlex100: An improved tool for the genetic analysis of pumas**
*** ALEX ERWIN, Robert R. Fitak, and Melanie Culver

3:40 p.m. 33 **Functional genomics of the endangered Florida panther**
*** ALEX OCHOA, David P. Onorato, Robert R. Fitak, and Melanie Culver

4:00 p.m. 34 **Influence of Natural and Anthropogenic Disturbances on Multi-Scale Black Bear Habitat Selection**
*** SUSAN BARD and James W. Cain III

4:20 p.m. 35 **Cross-fostering: a novel tool for Mexican wolf recovery**
JULIA SMITH, Susan Dicks, and Allison R. Greenleaf

4:40 p.m. 36 **Towards an increased understanding of space use and poaching risk in rhinos: vegetation mapping in the lowveld of South Africa**
*** MELISSA MERRICK, John L. Koprowski, Craig Spencer, and Michael Stokes

5:00 p.m. 37 **Characterization of epigenetic variation in endangered Sonoran pronghorn, *Antilocapra americana sonoriensis***
Erin Vaughn and MELANIE CULVER

5:20 p.m. 38 **Assessing translocated pronghorn adult and fawn survival in Fort Stanton, New Mexico**
EMILY CONANT, Courtney Threadgill, Mark C. Wallace, Warren C. Conway, Stewart G. Liley, Ryan L. Darr

## Wildlife Session 4
***Ballroom C***

3:20 p.m. 39 **Presence-only modelling reveals potential major shifts in suitable climatic niches for Western North American bats**
Piccioli Cappelli, Mattia, Hugo V. Rebelo, DAN TAYLOR, Trish Badeen, Sally R. Butts

3:40 p.m. 40 **Once upon a time in Mexico: prehistoric habitat suitability of the spotted bat**
DANIEL SANCHEZ, Trish Badeen, Sally R. Butts

4:00 p.m. 41 **A Review of Echolocation Detection Studies**

*** CLARISSA STARBUCK and Carol Chambers

4:20 p.m. 42 **Does a gate's design or length of time installed affect bat use and behavior at abandoned mines in western U.S.?**
*** ABIGAIL TOBIN and Carol Chambers

4:40 p.m. 43 **Beyond the bat – bats as drivers of bacterial biodiversity in abandoned mines of Arizona, New Mexico, and Utah**
VIACHESLAV FOFANOV, Crystal M Hepp, Faith M. Walker, Colin J. Sobek, Daniel E. Sanchez, and Carol L. Chambers

5:00 p.m. 44 **Investigating Bat Actinobacterial Microbiota and Natural Defenses against White-nose Syndrome**
Northup, Diana, DEBBIE BUECHER, Nicole Caimi, Paris Hamm, Andrea Porras-alfaro, Ara Kooser,, Jesse Young, and Ernie Valdez

5:20 p.m. 45 **Upping the ante: bat species identification from gobs of guano**
Faith Walker, COLIN SOBEK, Dan E. Sanchez, and Carol L. Chambers

## Wildlife Session 5

***Spruce***

3:20 p.m. 46 **Flat-tailed Horned Lizard Demographic Monitoring in the Yuma Desert Management Area (2008-2015), Arizona**
ASHLEY GRIMSLEY, Daniel J. Leavitt, and Nicholas B. Heatwole

3:40 p.m. 47 **Using Non-invaisive sampling methods to reduce human-wildlife interactions on Camp Navajo, an Arizona Army National Guard Installation**
Dan Sturla, Joel M. Diamond, and HANNAH TELLE

4:00 p.m. 48 **Evaluating bat use on the Barry M. Goldwater Range East**
JOEL DIAMOND, Ronald Mixan, and R. Nathan Gwinn

4:20 p.m. 49 **Combining non-invasive fecal sampling of genetics and physiology: how does considering individual effects influence results?**
DAVE CHRISTIANSON and Stephanie E. Doerries

4:40 p.m. 50 **Response in Songbird Abundance to Forest Treatments on Camp Navajo, Arizona**
RUSSELL GWINN, Joel M. Diamond, Daniel Sturla, and Emily H. Scobie

5:00 p.m. 51 **Monitoring of Sonoran Desert Tortoises on DOD facilities in Arizona**
DANIEL LEAVITT

5:20 p.m. 52 **Response of forest dwelling bats to forest management treatments on Campo Navajo**
JOEL DIAMOND and Daniel K. Sturla

# Poster Session

**Foyer**

*4:30 – 6:30 p.m.*

107 **Drought modifies land-use effects on arthropod communities in an urban desert ecosystem**
*** SKY ARNETT-ROMERO (Undergraduate), Bridget Harding (Undergraduate), Daniel Allen, and Albert Ruhi

108 **Examining sexual dimorphism in brown hyenas using skeletons collected in southwestern Namibia**
*** MIRANDA BUTLER-VALVERDE (Undergraduate), Ingrid Wiesel, and Gary Roemer

109 **Scurrying Squamates; a study of lizard movement across various trail types in the Bosque of Albuquerque, New Mexico**
COLIN DALY, Sam Lohman, and Remi Ward

110 **Remote Monitoring of Mammalian Fauna in Southern Arizona and Northern Mexico for Community-based Conservation**
*** DEAN GOEHRING (Undergraduate)

111 **Can elementary-school students understand climate change science and its effects on local wildlife?**
*** JACQUELINE GREENE (High School)

112 **Climate anomalies and time modify land-use effects on bird community structure in an urban desert ecosystem**
BRIDGET HARDING, Sky Arnett-Romero, Daniel Allen, Albert Ruhi, and Heather Bateman

113 **Mammalian Inventory of New Mexico's Organ Mountains: Centerpiece of the Organ Mountains-Desert Peaks National Monument**
*** JUSTIN W. HEBERT (Undergraduate), Jennifer K. Frey, Quintin Dean

114 **Anuran species inventory and *Batrachochytrium dendrobatidis* (chytrid) survey along the Wild and Scenic section of the Rio Chama and the Rio Grande in Albuquerque**
*** ABI HOWELL (High School), Sierra Spader, and Grace Tenorio

115 **Population Dynamics in Fragmented Habitats: Is the Pika Population in Bodie State Historic Park a True Metapopulation?**
*** SABRINA F. JONES (Undergraduate), ANDREW NEMECEK, and John D. Nagy

116 **Assessment of Raptor Migration Corridors in Arizona's Sky Islands**

LAURA MCHUGH and R. William Mannan

117 **Northward summer migration by non-breeding golden eagles from the southwestern United States**
ROBERT K. MURPHY, Dale W. Stahlecker, Kenneth "Tuk" Jacobson, Brian A. Millsap, Chad Smith, Emily Bjerre

118 **Human encounters with rattlesnakes in and around Phoenix, Arizona**
*** STEVEN PITTS (Undergraduate) and Ivana Mali

119 **Breeding habitat selection of the western distinct population of the yellow-billed cuckoo (*Coccyzus americanus*) within Audubon Arizona Important Bird Areas**
STEVEN S. PRAGER

120 **Identifying Individual Skunks Using Pelage Patterns and Its Application to Rabies Management**
DYLAN RAY, Theresa Rizza, David Bergman, and Tad C. Theimer

121 **Bunny Business: jackrabbit population dynamics in the Sevilleta NWR**
CLAIRE REARDON

122 **Phylogenomic analysis of bobwhite quail in Southern Arizona and Mexico**
*** KARLA VARGAS (Graduate), Brown, David, and Culver, Melanie

123 **Spatial Ecology of Gray Foxes (*Urocyon cinereoargenteus*) in Southeastern Arizona**
AMANDA M. VEALS, John L. Koprowski, Kurt C. VerCauteren, and David L.Bergman

124 **Change of high school students' attitudes toward snakes with and without live snakes in education programs**
*** CLAIRE E. WILKINS (High School)

125 **Characterizing Marine Faunal Community Composition Across the Gulf of California Using Next-Generation Sequencing of Environmental DNA**
ELDRIDGE WISELY and Melanie Culver

126 **A habitat suitability model for the Dusky Grouse in New Mexico**
*** JOSEPH A. YOUTZ (Undergraduate), Reza Goljani, and Jennifer K. Frey

## *Saturday, February 4, 2012*

### Fisheries Session 4
***Ballroom A***

8:00 a.m. 53 **Effect of length-based harvest regulations for trophy and recreational *Ictalurus* fisheries**
DAVID R. STEWART

8:20 a.m. 54 **Assessment of time-lapse trail cameras to monitor angler use on Arizona lakes and streams**
KRISTOPHER J. STAHR

8:40 a.m. 55 **Evaluating effectiveness of side-scan sonar in assessing littoral habitat diversity in reservoirs**
AMBERLE K. JONES

9:00 a.m. 56 **Two case findings: Possible Loma salmonae in yearling apache trout at Silver Creek hatchery and the identification of a highly pathogenic form of Saprolegnia infecting and killing rainbow trout and apache trout at Tonto Creek hatchery**
JOE MARCINO

9:20 a.m. 57 **The Fate of Stocked Trout in Arizona Streams**
RYAN MANN

9:40 a.m. 58 **Weight counts in aquaculture: Debunking some myths**
ETHAN B. MOWER

10:00 a.m. Break (20 minutes)

## Wildlife Session 6
***Ballroom B***

8:00 a.m. 59 **Plagued by epidemics: how cats, woodrats and human debris make the case for a one health approach in Arizona**
ERIN NIGON, Hayley Yaglom, Laura Adams4, Stephen Everett, Craig Levy, and Carrington Hilson

8:20 a.m. 60 **Home on the range: radiotelemetric assessment of home ranges in antelope jackrabbits for the first time**
*** MARIA ALTEMUS, John L. Koprowski, and David E. Brown

8:40 a.m. 61 **Relatedness of the Tamaulipas jackrabbit (*Lepus altamirae*): The case of Mexico's missing white-sided jackrabbit**
KARLA VARGAS, ELDRIDGEWISELY, David Brown, and Melanie Culver

9:00 a.m. 62 **Climate effects in the cache behavior of the Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*)**
*** CALEBE MENDES, Mauro Galetti, and John Koprowski.

9:20 a.m. 63 **Habitat use of the San Bernardino flying squirrel in a post fire landscape**
*** MAXWELL MAZELLA and John Koprowski

9:40 a.m. 64 **Genetic and Phenotypic Variation Among Fox Squirrels in Eastern North Carolina**
*** KENDELL BENNETT and Laura E. DeWald

10:00 a.m. Break (20 minutes)

## Wildlife Session 7

***Ballroom C***

8:00 a.m. 65 **A method for assessing presence of the endangered New Mexico meadow jumping mouse**
*** RACHEL HARROW Russell Benford, Valerie Horncastle, and Carol L. Chambers

8:20 a.m. 66 **Wolves of the rodent wold: Species differences in grasshopper mouse howls and prospects for automated monitoring of an indicator species**
BRET PASCH

8:40 a.m. 67 **The diverse world of New Mexico meadow jumping mouse**
CAROL CHAMBERS, Judith Springer, Kirstin Olmon Phillips, Valerie Horncastle, Faith M. Walker, Jennifer Frey, and Viacheslav Y. Fofanov

9:00 a.m. 68 **Detection rates during surveys of the endangered New Mexico meadow jumping mouse**
*** IAN PERKINS-TAYLOR, and Jennifer K. Frey

9:20 a.m. 69 **Effects of ambient light on puma, deer, and elk activity**
*** SCARLET SELLERS and Travis W. Perry

9:40 a.m. 70 **Top-Down and Bottom-Up Forces on Central New Mexico Mule Deer**
JACOB KAY and James W. Cain III

10:00 a.m. Break (20 minutes)

## Wildlife Session 8

***Spruce***

8:00 a.m. 71 **Too dry for lizards: rainfall influence on lizard microhabitat use in an experimental rainfall manipulation within piñon-juniper**
MASON RYAN, Ian M. Latella, J. Tomasz Giermakowski, Howard Snell, Steven Poe, Robert E. Pangle, Nathan Gehres, William T. Pockman, and Nate G. McDowell

8:20 a.m. 72 **Evaluating the effectiveness of citizen science in aiding the conservation of two declining gartersnake species in the Verde River Watershed, Arizona**
*** NOELLE FLETCHER, Erika M. Nowak, and Erik Nielsen

8:40 a.m. 73 **Native and nonnative prey availability and diet of northern Mexican gartersnakes in north-central Arizona**

*** IAIN EMMONS, Erika M. Nowak, Tad C. Theimer, Carol L. Chambers, and Kayla Lauger

9:00 a.m. 74 **Microhabitat evaluation for northern Mexican gartersnakes at Bubbling Pond Hatchery**
*** TIFFANY SPRAGUE, Heather L. Bateman, Erika M. Nowak

9:20 a.m. 75 **Current and future landscape-level suitability models for two species of gartersnakes from Arizona and New Mexico and their implications for management**
TOM GIERMAKOWSKI, Erika M. Nowak, James R. Hatten, Matthew J. Johnson, Jennifer A. Holmes

9:40 a.m. 76 **Demography of canyon treefrogs in desert mountain canyons**
*** ERIN ZYLSTRA, Robert J. Steidl , Don E. Swann, Blake R. Hossack, and Erin Muths

10:00 a.m. Break (20 minutes)

## Fisheries Session 5 and WOW Panel

***Ballroom A***

10:20 a.m. 77 **Effect of Enrichment in the Hatchery on the Performance of Brook Trout and Atlantic Salmon**
BRYAN D. FERGUSON

10:40 a.m. 78 **Mechanical removal of Green Sunfish (Lepomis cyanellus) in East Ash Creek, Bill Williams Drainage**
DAVID PARTRIDGE

11:00 a.m. 79 **The Resilience of Sea Turtles to Climate Change through a Quantitative Framework**
NICHOLE ENGELMANN

11:20 a.m. 80 **Ground-Based Thermal Imaging of Stream Surface Temperatures: Technique and Evaluation**
SCOTT A. BONAR

11:40 a.m. 81 **Comparison of AFS standard snorkeling techniques to eDNA sampling techniques**
ROY M. ULIBARRI

12:00 a.m. 82 **Women of Wildlife Panel**
KATHY GRANILLO, KAY NICHOLSON, AND SERRA HOAGLAND

12:20 a.m. 83 **Women of Wildlife Panel – Continued**
KATHY GRANILLO, KAY NICHOLSON, AND SERRA HOAGLAND

12:40 a.m. 84 **Women of Wildlife Panel – Continued**

## Wildlife Session 9

***Ballroom B***

10:20 a.m. 85 **Spatially explicit models of peripheral squirrel populations inform management of both invasive and endangered species**
EMILY GOLDSTEIN, and John L. Koprowski

10:40 a.m. 86 **Variable interactions between tree squirrel species in areas of natural and anthropogenic overlap**
*** JONATHAN DERBRIDGE and John L. Koprowski

11:00 a.m. 87 **What Everyone Wants to Know About Permits!**
CHRISTINA KONDRAT-SMITH

11:20 a.m. 88 **Habitat suitability model of American hog-nosed skunk in Grand Canyon National Park**
LANCE T. MURRAY, Joel Barnes, Larry Stevens, Brandon Holton, Jeri Ledbetter, and Jeff Jenness

11:40 a.m. 89 **Isotopic evidence links drought stress and bottom-up regulation in a grassland herbivore**
CHUCK HAYES, William A. Talbot, and Blair O. Wolf

12:00 a.m. 90 **Pre-dispersal exploratory movements - and implications for dispersal in fragmented landscapes**
ANNIKA KEELEY

12:20 a.m. 91 **AgDiscovery Programs at Virginia State University and University of Hawaii at Manoa**
*** MEAGAN VANPELT, and Cody J. Bergman

## Wildlife Session 10

***Ballroom C***

10:20 a.m. 92 **Preliminary Sightability Model Development for Arizona Elk Populations**
KIRBY BRISTOW

10:40 a.m. 93 **Animal migration altered by cheatgrass and concomitant shifts of fire and phenology: The Kaibab mule deer example**
RICHARD LUCAS

11:00 a.m. 94 **Effects of non-motorized recreation on mid-size and large mammals in the San Francisco Bay area**
*** MICHELLE REILLY

11:20 a.m. 95 **An Evaluation of Off-Highway Vehicle Influence on Space Use by Kit Foxes in Arizona**
ANDREW JONES

11:40 a.m. 96 **Conserving Nature's Stage**
PAUL BEIER

12:00 a.m. 97 **Natural resource applications of the phenology data and information housed in the National Phenology Database**
ERIN POSTHUMUS

12:20 a.m. 98 **Using citizen science to monitor avian communities in the Arizona Sky Islands**
JAMIE SANDERLIN

## Wildlife Session 11

***Spruce***

10:20 a.m. 99 **Multiscale analysis of Mexican spotted owl breeding site selectivity vs adjusted reproduction indexes (ARPI)**
*** SERRA HOAGLAND

10:40 a.m. 100 **Evaluating Desired Conditions for Mexican Spotted Owl Nesting and Roosting Habitat**
JOSEPH GANEY

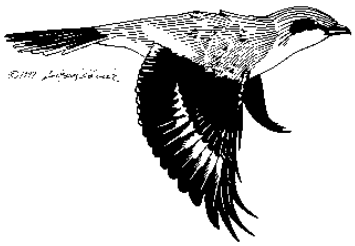
11:00 a.m. 101 **First- through fourth-year dispersal of golden eagles from natal areas in the Colorado Plateau Region of the Southwestern United States**
ROBERT MURPHY

11:20 a.m. 102 **Available data support protection of the Southwestern Willow Flycatcher under the Endangered Species Act**
TAD THEIMER

11:40 a.m. 103 **Population genetic diversity and structuring in yellow-billed cuckoos**
*** **S**HANNON MCNEIL

12:00 a.m. 104 **Evaluating the use of PIT tags and satellite transmitters to model the survival and movements of Band-tailed Pigeons in New Mexico**
CHRIS COXEN

12:20 a.m. 105 **Spatial ecology of the Lower Colorado River Valley population of greater sandhill cranes**
*** COURTNAY CORNING



*** Denotes student paper

## Listed Alphabetically by Senior Author

**60 Home on the range: radiotelemetric assessment of home ranges in antelope jackrabbits for the first time**

*** ALTEMUS, MARIA (Graduate)[1], John L. Koprowski[2], and David E. Brown[3]. [1]University of Arizona, School of Natural Resources and the Environment, 1064 E. Lowell St., Tucson, AZ 85721; maltemus@email.arizona.edu. [2]University of Arizona, School of Natural Resources and the Environment, Room N335, 1064 E. Lowell St., Tucson, AZ 85721; squirrel@ag.arizona.edu. [3]Arizona State University, School of Life Sciences, Room LSC 356, 401 E. Tyler Mall, Tempe AZ 85281; david.e.brown@asu.edu.

Oral Presentation

Gaining novel information about a little-known species is important to understand how that species interacts and functions with plants and animals within the ecosystem. The antelope jackrabbit (Lepus alleni) is an understudied lagomorph found in the Sonoran Desert of Arizona and Mexico. Basic ecological information on this species is lacking beyond historical responses to rangeland conditions. We used radio telemetry for the first time on antelope jackrabbits to gather novel data on home range size and seasonal movement patterns on the Buenos Aires National Wildlife Refuge in south central Arizona. We found that mean home range size of antelope jackrabbits is 29.14 ± 15.58 ha (n=12). Male and female home range size did not differ in size and it does not appear that home range varies based on habitat differences. Despite the seasonal landscape of the desert grasslands, antelope jackrabbits traverse stable ranges from wet to dry seasons. Our findings indicate that antelope jackrabbit home ranges are comparable to range sizes reported for the widespread black-tailed jackrabbit (*Lepus californicus*) as well as the endangered Tehuantepec jackrabbit (*Lepus flavigularis*). Our results will allow us to better understand how these hares are using the desert landscape, in a complex and ever-changing environment.

**107 Drought modifies land-use effects on arthropod communities in an urban desert ecosystem**

*** ARNETT-ROMERO, SKY (Undergraduate)[1,2], Bridget Harding (Undergraduate)[1,3], Daniel Allen[4,5], and Albert Ruhi[4,6]. [1]Central Arizona-Phoenix Long-Term Ecological Research, 3942 E. Yucca St. Phoenix, Arizona, 85028. [2]Sky.Arnett-Romero@gmail.com. [4]brhardin@asu.edu. [4]College of Letters and Sciences, Wrigley Global Institute of Sustainability, Arizona State University, 6073 S Backus Mall, Mesa, AZ 85212. [5]Daniel.c.allen@asu.edu. [6]Albert.Ruhi@asu.edu.

Poster

Central Arizona Phoenix Long-term Ecological Research (CAPLTER) has surveyed ground-dwelling arthropod communities inhabiting different types of land-use areas throughout the greater Phoenix metropolitan area since the late 1990s. Here we investigate arthropod pitfall traps surveyed from 2002-2014 across desert, agriculture, mesic urban, mesic/xeric mixed urban, and xeric urban areas. Effects of land use and time Abundance and species richness were

explored using General Linear Mixed Models (GLMMs). We found significant land-use X time interactions for both arthropod abundance and richness, indicating that the effects of land use on arthropod communities were not consistent over time. Accordingly, we investigated variation in land-use effect sizes (as measured using Cohen's d) might be affected by drought and time, but effects drought and time did not explain significant variation in land use effect sizes. However, further analyses did indicate that the effects of droughts on arthropod abundance and species richness differed depending on land use type. Drought had strong effects on arthropod abundance in desert land uses, but weaker effects on arthropod abundance in agriculture and urban land uses. For arthropod richness, droughts explained more variation for mesic sites than others. Future work on this project will be to investigate the long-term effects of land use on beta diversity patterns and community structure of arthropod communities.

**34 Influence of Natural and Anthropogenic Disturbances on Multi-Scale Black Bear Habitat Selection**

*** BARD, SUSAN[1], and James W. Cain III[2]. New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 South Espina Knox Hall 132, Las Cruces, NM 88003; sbard@nmsu.edu. [2]U.S. Geological Survey New Mexico Cooperative Fish and Wildlife Research Unit, New Mexico State University, Department of Fish, Wildlife, and Conservation Ecology, 2980 South Espina, Knox Hall 132, Las Cruces, NM 88003; jwcain@nmsu.edu.

Oral Presentation

The combined effects of long-term fire suppression, logging, and overgrazing have negatively impacted many southwestern forests, resulting in decreased habitat quality for wildlife, and more frequent wildfires. Degraded forest conditions have resulted in calls for restoration of the historic forest structure and fire regimes. However, there is currently little information on the effects of wildfires or forest restoration treatments on black bears in the semi-arid forests of the southwestern United States. Yet, to develop effective management plans for black bears it is essential that we understand how black bears are influenced by these disturbances, both of which are becoming more prevalent and widespread across southwestern forests. We anticipate discussing preliminary results regarding the assessment of habitat characteristics at bed sites of radio-collared black bears to determine whether disturbances are influencing selection on a microscale. In addition, we will discuss future data collection and analyses including landscape-level habitat selection and space use patterns of black bears in response to forest restoration treatments and wildfires, as well as assessing changes in abundance of key forage species for black bears. By providing information on black bear responses to these disturbances, we can make more informed decisions on future forest restoration projects that will maintain or increase black bear populations while forest restoration projects are occurring on the landscape. We will also be better poised to anticipate the influence of wildfires on black bear populations in the fire prone forests of the southwest.

**96 Conserving Nature's Stage**

BEIER, PAUL, School of Forestry, Northern Arizona University, Flagstaff AZ 86011 USA, paul.beier@nau.edu.

Oral Presentation

I advocate using geodiversity or enduring features (landform, bedrock, soil, topography, and other abiotic features) in a coarse filter strategy for conservation planning in the face of climate change. The approach is attractive because it focuses conservation on the physical factors that create diversity, allowing species and communities to rearrange in response to a changing climate. It provides a logical structure for designing conservation networks that assume nature is dynamic and resilient, and challenges us to create arenas for evolution not museums of the past. This presentation: (1) describes ecological theory, and biogeographic and paleo-ecological evidence supporting the idea geodiversity is a major driver of species distributions and ecological processes in terrestrial systems; (2) presents a global map of 670 geodiversity types (land facets) and how much of each type is protected in each of 8 biogeographic realms; (3) summarizes evidence that geodiversity is a good surrogate for biodiversity of terrestrial plants, mammals, birds, amphibians, and reptiles, and 11 marine phyla; (4) describes cases studies in which geodiversity targets have been incorporated into traditional conservation plans without increasing the total area prioritized or decreasing the achievement of other targets; and (5) explains how geodiversity can be incorporated into the work of agencies that are mandated to focus on conservation of particular species. To extend the metaphor of the ecological theater and the evolutionary play, I conclude that we should now focus on conserving nature's stage for the evolving cast of players in the coming era of climate change.

**64 Genetic and Phenotypic Variation Among Fox Squirrels in Eastern North Carolina**

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Oral Presentation

The longleaf pine (*Pinus palustris* Mill) ecosystem serves as habitat for the eastern fox squirrel (*Sciurus niger* L) in the southeastern United States and has been reduced in size and fragmented. Fragmentation often leads to loss of genetic diversity and an increase in population structure of species. To determine if this is happening in the fox squirrels of North Carolina, five microsatellite loci and phenotypic variation were used to compare geographic variation among fox squirrel populations. Fox squirrels showed a low level of population subdivision indicated by FST values of 0.010 to 0.017. In contrast, FIS values were higher (0.222 to 0.230) indicating that inbreeding could be causing a loss of genetic diversity. Linear regression showed a positive correlation between individual weight and longitude and ANOVA analysis revealed squirrels were significantly heavier and shorter west of 78°W longitude, which runs just east of Wilmington N.C. North Carolina fox squirrels were found to be less heterozygous than those of the Midwestern United States, and one locus (FO-41) showed a major decrease in heterozygosity since 1983. Future management of fox squirrels should focus on maintaining habitat and population numbers sufficient to avoid inbreeding. Introducing individuals from other areas may help to increase overall genetic diversity which should also conserve the overall fitness of North Carolina's fox squirrels as it has with other species.

**92 Preliminary Sightability Model Development for Arizona Elk Populations**

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Oral Presentation

Sightability models have been developed in several western states to account for differential detection probabilities of elk (Cervus elaphus) due to demographic, behavioral, weather or habitat parameters. Many of these models have been developed in states where elk follow seasonal migratory patterns which concentrate animals on "winter range" areas. However, these concentrations of elk into areas where snow-covered substrate facilitates observation from aircraft do not occur predictably in Arizona. Elk in Arizona tend to concentrate most during early fall over a wider range of habitats than the typical "winter range" of many western states. To develop a sightability model specific to these challenges, we completed two years of fall helicopter surveys, with plans to complete a third session in 2016. To date we have used logistic regression modeling based on collected sightability covariates to differentiate locations of elk detected from those known to have been missed on surveys. We used information theory to rank a set of candidate a priori models to determine which covariates affected sightability and select an algorithm to account for animals missed on future aerial surveys. Our preliminary AIC ranking indicated the global model including covariates for: vegetative cover, vegetation type, burn category, group size, activity, and ambient light performed best. The global model correctly classified 90.6% of observed and 87.8% of missed groups of elk. Although application of this model requires greater information than is typically recorded by aerial observers, it may improve the ability to estimate elk numbers in Arizona's diverse landscape.

**108 Examining sexual dimorphism in brown hyenas using skeletons collected in southwestern Namibia**

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Poster

The brown hyena (Hyaena brunnea) is generally considered to be sexually monomorphic based on external measurements such as body length and shoulder height. However, there is evidence of slight differences in size between the sexes. The purpose of this study was to investigate for sexual dimorphism in brown hyenas using skeletons of known sex. Samples were collected in and near the Tsau//Khaeb (Sperrgebiet) National Park, Namibia. A total of 37 skeletal features, including dental, cranial, pelvic, and appendage aspects, were measured from a sample of 25 adult skeletons (11 female, 14 male). Independent t-tests were conducted using a Bonferroni correction to account for the inflated experiment-wise error rate associated with running multiple tests (p value = 0.001). Intersexual differences in the maximum lengths of the ulna, femur, palate and scapula were statistically detectable. To examine for a correlation between these key skeletal aspects within a sex, a Spearman's rank correlation coefficient was used. The scapula and femur were correlated in male brown hyenas suggesting that these measurements should not be used together to discriminate the sex of skeletons of brown hyenas. The skeletal features that differed

between the sexes were larger in males, implying that males are taller and have longer rostrums than females. This suggests the presence of sexually dimorphic characteristics in brown hyenas and the possibility of intrasexual selection in males, perhaps reflecting their nomadic mate-searching tactics or male-male conflict for mates.

**67 The diverse world of New Mexico meadow jumping mouse**

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Oral Presentation

Understanding habitat and diet of the endangered New Mexico meadow jumping mice (*Zapus hudsonius luteus*) can assist in recovering the species. The jumping mouse is considered a riparian obligate that uses tall, dense herbaceous vegetation along perennial flowing water. The diet of the jumping mouse is not clearly defined but observations from other subspecies and a sample in New Mexico indicate they may shift from a dominance on insects shortly after emergence from hibernation in spring to seeds just before entering hibernation in fall. During summer 2015, we surveyed 11 sites on the Apache-Sitgreaves National Forest in Arizona. We assessed plant species diversity and dominance and recorded presence of jumping mice through use of live traps, track plates, or visual records. To investigate diet, we collected feces from captured jumping mice for genomic analysis and hair samples from jumping mice captured in Arizona (n = 17) and New Mexico (n = 11) for stable isotope analysis. We recorded >375 plant species among our 11 sites but only 7 plant species were common to all sites. We recorded presence of jumping mice at 10 sites and collected feces from 20 mice at 5 sites. Stable isotope analysis indicated jumping mice in Arizona are likely herbivores but New Mexico populations may include arthropods in their diet. Genomic sequencing of feces from 4 jumping mice (preliminary data) suggested a diverse diet (feeding from plants in the families Salicaceae, Solanaceae, Poaceae, Amaranthaceae, Phrymaceae, Fabaceae, Brassicaceae and more) for the jumping mouse in Arizona.

**49 Combining non-invasive fecal sampling of genetics and physiology: how does considering individual effects influence results?**

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Oral Presentation

Research on wildlife has traditionally been invasive, with the potential to harm individuals, detrimentally affect populations, and bias results. These consequences are important to consider when studying species of conservation concern. The U.S. population of endangered Sonoran pronghorn (*Antilocapra americana sonoriensis*) ranges across DOD and other federal lands in southern Arizona and has declined in recent decades as human activity has increased. Understanding human impacts on Sonoran pronghorn is essential to making sound management decisions that facilitate recovery. Non-invasive sampling is an effective way of collecting meaningful information about wildlife populations while minimizing the same kinds of impacts under investigation. Technological advancements now allow us to apply non-invasive techniques to fecal samples, permitting both genetic identification and measurement of hormone concentrations from a single sample. Most physiological studies of wild ungulates have focused on documenting stress hormone concentrations within populations. Monitoring at the individual level does not usually occur due to logistic and financial limitations associated with genetic identification of fecal samples. By combining genetics with endocrinology, we measured how levels of the stress hormone cortisol varied within and among individual Sonoran pronghorn over a 3-week period in June 2014. Assessing age (fawn or adult) and sex differences in cortisol levels from raw data, following standard procedures for non-invasive sampling analysis, indicated significantly lower cortisol levels in fawns than adults. When considering the effects of individual in a mixed-effects model, age and sex did not significantly impact cortisol levels. Our findings have important implications for currently acceptable methodologies measuring stress responses of wildlife species via fecal glucocorticoid concentrations.

**38 Assessing translocated pronghorn adult and fawn survival in Fort Stanton, New Mexico**

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Oral Presentation

Translocations are a common component of pronghorn (*Antilocapra americana*) management across the western United States to augment declining or reestablish extirpated populations. However, post translocation monitoring has either been minimal or non-existent. In 2013, the New Mexico Department of Game and Fish entered into an agreement with a ranch located east of Cimarron, New Mexico to minimize winter crop depredation by translocating pronghorn while simultaneously relocating those captured individuals to supplement declining populations in the southeast region of the state. We monitored and assessed survival of adult pronghorn translocated to Fort Stanton, NM in January 2013 and 2014. Low fawn:doe ratios were observed in 2013 (6:100) which resulted in a closer examination of fawn survival from translocated does in 2014 and 2015. A total of 144 adults were translocated to Fort Stanton, New Mexico (61 male

and 83 female). Adult survival was estimated for both year of translocation (2013 and 2014) and the year post translocation (2013 animals in 2014). Adult seasonal survival was high both years of translocation (0.68 + 0.08; 2013 and 0.91 + 0.06; 2014) and the year post translocation (0.95 + 0.05). Twenty nine fawns were captured in 2014 and 31 fawns were captured in 2015. Seasonal fawn survival was 0.01 (+ 0.1) in 2014, and 0.04 (+ 0.3) in 2015. High adult survival indicates that these translocation efforts were successful in establishing a viable adult population. However, poor fawn survival in both years suggests that future efforts should focus upon identifying and remedying potential limiting factors negatively impacting fawn survival in this localized population.

### 105 Spatial ecology of the Lower Colorado River Valley population of greater sandhill cranes

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Oral Presentation

Due to lack of baseline ecological information on the Lower Colorado River Valley population (LCRVP) of greater sandhill cranes (Grus canadensis tabida), management efforts are convoluted and further research on the winter ecology, migratory paths, and breeding distribution of this population is warranted. We fitted 18 greater sandhill cranes on three study sites in southwest Arizona, southeast California, and west-central Idaho January–July 2014 with platform transmitter terminals (PTTs). PTTs recorded four global positioning system locations per day per bird. For our overwinter space use assessment, we calculated average winter home range size using the Brownian bridge movement model (BBMM). Average winter home range size was 18,710 ha (SE= 3809). In the overwinter habitat selection study, we used selection ratio-based resource selection functions and found habitat types including wetlands, woody wetlands, trees, open water, and shrubland were selected for at the population level. In the migratory connectivity and new summer area study, we used the BBMM to assess migration corridors and migratory pathways, then outlined all PTT locations outside of the known LCRVP breeding distribution during the 2014 and 2015 summers. Fall and spring migration corridors covered similar areas. We identified 16 stops throughout the three migration events and we identified 3 new summer units. Targeting habitat management of roost site availability on the LCRVP wintering grounds, at migratory stops, and conducting comprehensive banding efforts on western sandhill crane populations could address winter and migratory concerns for this population and provide further evidence of intermingling between western populations.

### 104 Evaluating the use of PIT tags and satellite transmitters to model the survival and movements of Band-tailed Pigeons in New Mexico

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Oral Presentation

Survival estimates and habitat suitability data are critical for effective species management. Our goal is to establish a standardized population monitoring protocol through the novel use of passive integrated transponder (PIT) tag based mark-resight survivability models. A total of 648 band-tailed pigeons were PIT tagged at three sites in New Mexico from 2013 to 2015. Recapture and resight data will be used to model within and between season survival by sex, age, and site. Band-tailed pigeon movement data were collected by satellite platform terminal transmitters (PTTs) fitted to 15 individuals in 2015. These data will be used in conjunction with biotic and abiotic spatial habitat data to develop band-tailed pigeon MaxEnt habitat suitability models. These models will be used to detect trends in bird habitat use in response to management practices and fire. Locations will also be used to generate home range estimates for each site. Fall migration routes and wintering ground locations will be presented, and represent the first ever collection of detailed migration data for Four Corners band-tailed pigeons.

### 109 Scurrying Squamates; a study of lizard movement across various trail types in the Bosque of Albuquerque, New Mexico

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Poster

There is a often a conflict between wildlife and human recreation, especially in or near highly populated, urban settings, such as Albuquerque, NM. Recent trail construction in the bosque (riparian forest on either side of the Rio Grande) has led to interest from the public and natural resource managers in determining the best management practices as they relate to wildlife. Study of lizard movement can be used to better understand the effects of ecosystem manipulations. We set out to track lizard movement across a trail consisting of a crusher fine and a dirt path trail in order to determine if trail substrate effects lizard movement. We used visual behavior surveys as well as mark-recapture in order to measure lizard movement. A total of 40 traps (20 on each trail; 10 on each opposing side) were placed along the two sections of trail. After 640 trap nights, we caught 37 lizards (3 species) on the crusher fine trail and 30 lizards (2 species) on the dirt trail; however, there were no recaptures. Even though our mark-recapture study did not identify lizard movement, our three walking surveys concurred that lizards moved across both trails. From our pitfall measurements, we can see that the population of lizards around the dirt trail is very similar to the population around the crusher fine trail. As well, our walking surveys suggest that the crusher fine trail does not inhibit lizard movement anymore than the dirt trail does.

### 86 Variable interactions between tree squirrel species in areas of natural and anthropogenic overlap

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Oral Presentation

Species invasions comprise a global conservation threat, and where invaders are ecologically similar to native wildlife, niche separation may predict their potential to persist in syntopy. Native Abert's squirrels (*Sciurus aberti*) and red squirrels (*Tamiasciurus hudsonicus*) are syntopic in the White Mountains (WM) and Kaibab Plateau (KP), Arizona, but Abert's squirrels introduced to the Pinaleño Mountains (PM) in the 1940s are considered a threat to the endangered Mount Graham red squirrel (MGRS; *T. h. grahamensis*). One potential impact is through pilferage by non-caching Abert's squirrels from MGRS middens, which could reduce nutrition and increase energy expended in territorial defense and replacement of lost food. We used remote cameras at PM, WM, and KP middens and associated random points from 2012-2015 to test hypotheses on impacts of cache pilferage. We predicted Abert's squirrels would be observed at MGRS middens more than random points, but avoid WM and KP middens. We used mixed effects models to estimate cache pilferage. From 695 observations, introduced Abert's squirrels were significantly less likely to visit MGRS middens compared to random points. Abert's squirrels were not commonly observed at WM sites but also appeared to avoid middens. From 115 observations in a single season, Abert's squirrels were recorded at KP middens and random points equally. Our results suggest MGRS are not impacted by loss of food from middens, but may indicate territorial defense against introduced Abert's squirrels prevents pilferage at an energetic cost that KP red squirrels do not bear.

**48 Evaluating bat use on the Barry M. Goldwater Range East**

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Oral Presentation

In the past isolated capture events and roost surveys have documented ten bat species utilizing Barry M. Goldwater Range East (BMGRE). These records are temporally and spatially isolated. In order to increase the understanding of bat fauna we designed a study focused on determining the distribution of bat species across temporal and spatial scales on BMGR. We used a combination of monthly capture events, continuous acoustic recording at five water sites and seven cave/mine roosts and internal roost surveys to evaluate bat use on BMGRE. Sampling began in June of 2013 and sampling will continue until at least April of 2016. Our initial results indicate that the combination of these three sampling techniques is more effective than acoustic, capture or roost surveys alone. Using these methodologies we documented seven bat species through capture and roost surveys. We documented five additional bat species acoustically that have foraging and roosting affinities for the habitats on BMGRE and these records indicate a high likelihood of occurrence on BMGRE. Three additional species were detected acoustically that likely migrate across BMGRE in the spring and fall. Thus, this study has documented 12 bat species using BMGR East and an additional three that likely migrate across the installation.

**52 Response of forest dwelling bats to forest management treatments on Campo Navajo**

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Oral Presentation

The purpose of this long-term study was to evaluate, through pre- and post-treatment data, the effects of forest restoration treatments on forest dwelling bats within ponderosa pine forests on Camp Navajo. From 2005 to 2015, we monitored bat abundance and species diversity using 576 artificial bat box roosts at Camp Navajo Army National Guard Training Site in northern Arizona. We sampled bats on three to seven occasions between May and October, of each sample year. We captured 3,543 bats, comprising eight species. Species abundance varied by survey month, but generally peaked in late summer. Big brown bat (EPFU; *Eptesicus fuscus*) was the predominant species comprising 65% of overall captures. Bat use varied across; year, month, treatment, and time since treatment. We found that common species (EPFU, and Arizona Myotis [MYOC; *Myotis occultus*]) responded positively to timber management practices, with the combined thin and burn method being the most effective. This positive impact only lasted for six years, as use continually declined before equaling deferred treatment levels. Timber management had a net negative impact on less common species such as fringed myotis [MYTH (*Myotis thysanodes*) and southwestern myotis [MYAU (*Myotis auriculus*)] as their occurrence declined post treatment, but slowly increased as treated areas matured. Our long term study suggests that timber management practices have a dynamic impact to tree roosting bat species with observable impacts that vary by species and time since forest treatment.

## 22 Modeling patch occupancy to examine competition between energy development and wildlife

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Oral Presentation

The conflict between energy development and wildlife is analogous to competition between two species. In such cases, the superior competitor usurps a needed resource (habitat), thereby contributing to reduction and possible extirpation of the inferior competitor. For managers, a solution to this dilemma is finding a stable equilibrium in which both entities are able to persist via spatial or temporal separation. The difficulty in managing for a stable equilibrium is that energy development and wildlife populations are in constant flux. We created a spatially-explicit patch occupancy model to examine dynamics between oil and gas development and persistence of the Lesser Prairie Chicken (Tympanuchus pallidicinctus) (LPC) in southeastern New Mexico. If initially occupied patches were protected, LPC persisted beyond the 100 year modeling period. However, as rates of development increased, the number of years occupied patches remained connected decreased. In turn, as patch isolation increased, occupancy decreased. Thus, maintaining viable corridors among patches appears to be equally important as protecting occupied habitat.

## 73 Native and nonnative prey availability and diet of northern Mexican gartersnakes in north-central Arizona

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Oral Presentation

The northern Mexican gartersnake (*Thamnophis eques megalops*) is a semi-aquatic mesopredator and federally threatened species under the Endangered Species Act that has experienced range-wide population declines in the United States. One of the perceived leading threats to species survival is the loss of a native prey base from nonnative aquatic predators that include American bullfrog (*Lithobates catesbeianus*) and spiny-rayed fish in the families Centrarchidae and Ictaluridae. However, dietary descriptions for the species are limited to relatively few studies and confirmed records. Our objectives were to identify relative prey availability and prey use as part of a larger population demography and radio telemetry study for northern Mexican gartersnakes in north-central Arizona. We conducted minnow trap surveys from May 2012 through November 2014 and nonnative aquatic vertebrates dominated prey availability and species diversity numbers. We also observed 23 prey use events from 22 individual gartersnakes consisting of seven opportunistic encounters during radio tracking and 16 detections in minnow traps. Prey items consisted of native and nonnative aquatic vertebrates including 16 observations for bullfrogs and the first confirmed species records for centrarchid and ictalurid fish. Our findings have direct implications for species recovery efforts, and suggest that in certain watersheds where the native aquatic prey base is much-reduced or even extirpated, northern Mexican gartersnakes may be able to maintain viable populations by shifting to a diet comprised primarily of nonnative prey species.

## 32 PumaPlex100: An improved tool for the genetic analysis of pumas

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Oral Presentation

PumaPlex, a genotyping array designed for the Sequenom MassArray platform, is a recently developed tool for the genetic analysis of puma (*Puma concolor*) samples (Fitak et al., 2015). As opposed to traditional microsatellites, PumaPlex harnesses the advantages of another genetic marker, single nucleotide polymorphisms (SNPs) (Figure 1), and has been designed as a rapid, high-throughput, and cost effective method for gathering genetic data from pumas. The authors demonstrated that PumaPlex could accurately identify both individuals and sibling pairs and outperformed microsatellites by significant margins in scat samples. Fitak et al. discussed the weaknesses of PumaPlex, which, most importantly, includes the inability to detect low to moderate population subdivision. To address this weakness, we used an improved methodology to expand PumaPlex from one assay with 25 SNPs to PumaPlex100, 4 assays with 100 SNPs. As empirical studies and genetic theory suggest between 4 and 10 times more SNPs than

microsatellites are needed to detect subtle population subdivision (Knowles, 2010; Morin et al., 2009), the expanded number of markers should now be able to detect low to moderate population structure. This tool has a wide range of applications; it will first be used to examine population structure, estimate reproductive success for individuals, estimate relatedness between individuals, and determine paternity in a population of pumas where sport hunting was introduced halfway through the sample collection. Ultimately, PumaPlex100 is cheaper per sample than microsatellites, powerful enough to answer a wide array of questions, and provides results that can be fed into the Puma Genetic Database.

## 72 Evaluating the effectiveness of citizen science in aiding the conservation of two declining gartersnake species in the Verde River Watershed, Arizona

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Oral Presentation

Efforts to develop recovery plans for two federally Threatened species, the northern Mexican gartersnake (*Thamnophis eques megalops*) and narrow-headed gartersnake (*T. rufipunctatus*), have been hampered by field research challenges. Though large population declines have been documented, both species are difficult to detect using standardized survey methods, leading to knowledge gaps. In Arizona's Verde River Watershed, populations of these snakes occur in high-use areas. This study evaluated the effectiveness of citizen science in aiding the conservation of these species through obtaining data on both species' distributions in the Verde River Watershed. We created a citizen science website and smartphone application which allowed volunteers to report snake detections and provided training to a subset of volunteers. Citizen science detection rates and catch per unit effort for two field seasons were compared to standardized field methods and found to be similar. Two new distributions for one species were also reported. Cost-effectiveness analyses determined that citizen science incurred the second-highest costs, primarily due to initial development costs of the website/app. This study demonstrated the ability of citizen science to detect cryptic gartersnake species and aid in research effort and conservation planning.

## 43 Beyond the bat – bats as drivers of bacterial biodiversity in abandoned mines of Arizona, New Mexico, and Utah

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Oral Presentation

There are hundreds of thousands ofabandoned mines in western U.S. alone, with many serving as roosts for a variety of bat species. These sites are located not only in wilderness areas, but also adjacent to or within major human population centers. In these environments, bats, through their nutrient-rich guano, have long been thought of as a foundation species, supporting a diverse food web including arthropods that use guano as a food source, as well as predators that consume them. While bats are clearly important to this ecosystem, the degree to which their presence, species composition, and gut microbiota drive the diversity and stability of subterranean bacterial communities is not known. To assess these impacts, we sampled 27 abandoned mines located throughout Arizona, New Mexico, and Utah, collecting guano (fresh and cave-floor deposits) and arthropod samples. We have used a variety of barcoding, amplicon sequencing and shotgun metagenomics techniques to explore bacterial communities across multiple trophic levels (bat guano, associated arthropods). Our results to date suggest that bats and their guano microbiota drive the bacterial biodiversity and composition of their immediate subterranean ecosystem. In particular, we have observed bat guano pile microbiota affecting arthropod gut bacterial composition, with detritivorous insect gut communities most closely mimicking the microbiota of guano from which it was isolated. Shotgun metagenomic sequencing revealed a number of bacterial taxa persisting across the guano pile and arthropod gut niches. Finally, we observed bat species composition across different sites closely correlating with guano pile microbiome compositions.

## 100 Evaluating Desired Conditions for Mexican Spotted Owl Nesting and Roosting Habitat

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Oral Presentation

A recovery plan prepared for the threatened Mexican spotted owl (*Strix occidentalis lucida*) assumed that nesting habitat was a primary factor limiting distribution of Mexican spotted owls, and provided four desired conditions for identifying and managing potential nesting habitat. We used data from nest sites of Mexican spotted owls in the Sacramento Mountains, New Mexico, to evaluate how well these desired conditions and associated forest attributes described nesting habitat in this area. Nest sites featured higher levels of structural attributes included in the desired conditions than the surrounding stand, yet only 22% of sampled nest sites met all four conditions simultaneously and only 46 – 87% met single desired conditions. The best generalized

linear models using combinations of these four structural attributes plus canopy cover to distinguish between nest sites and random sites within owl home ranges all contained canopy cover and % of basal area in large trees. Relative importance values were high for both of these attributes (0.9998 and 0.9827, respectively), and confidence intervals around parameter estimates included zero for all other attributes evaluated. The present desired conditions did not consistently identify nesting habitat in this area, required managing for higher levels of structural attributes than were typically observed at owl nest sites, and did not include canopy cover, which was the single best predictor in the Sacramento Mountains. We recommend revising the desired conditions in the Sacramento Mountains to emphasize canopy cover and some attribute measuring the large tree component, and repeating this assessment in other geographic areas.

**75 Current and future landscape-level suitability models for two species of gartersnakes from Arizona and New Mexico and their implications for management**

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Oral Presentation

Within the Lower Colorado River Basin two species of gartersnakes are strongly associated with riparian areas and permanent water: the Mexican Gartersnake (*Thamnophis eques*) and the Narrow-headed Gartersnake (*T. rufipunctatus*). While the extent of distribution of these two species is relatively large, both species are currently patchily distributed in small populations and both species are listed as threatened under the Endangered Species Act. Aside from direct habitat loss and degradation and negative effects of non-native species on these snakes, changes in availability of permanent water in the future also threaten their long-term persistence. To provide spatially-explicit assessments of vulnerability useful at a landscape scale, we built models of suitability of current and future landscapes. To parameterize these models, we relied on climatic and hydrological predictions developed by the Bureau of Reclamation and its partners as well as remotely-sensed measures of vegetation from NASA. While average precipitation within the Colorado River Basin is not projected to change significantly by mid-century, mean annual runoff is projected to decrease and temperatures to increase. These changes will directly affect the availability of permanent water and riparian vegetation that surrounds suitable habitats of gartersnakes. Our results indicate significant changes in future landscape suitability for both species (up to 32% by mid-century), especially in the southern and peripheral parts of their extents of distribution. Given that large proportions of critical habitats are on federal lands, a finer scale examination of effects of hydrology and climate on habitats would prove invaluable for conservation of these two species.

**110 Remote Monitoring of Mammalian Fauna in Southern Arizona and Northern Mexico for Community-based Conservation**

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Poster

I investigated the importance of incorporating community-based conservation strategies to enhance the current paradigm of conservation and wildlife management. As a citizen with no affiliation to federal or state agencies, I conducted a mammalian species inventory in the Sky Island region of southern Arizona and northern Mexico using 5 non-invasive camera traps to monitor wildlife. The Santa Rita Mountains and Sierra Azul Mountains (Rancho El Aribabi) were chosen as study sites because of their similar composition of biotic communities, connectivity, and shared threats to wildlife. Monitoring was conducted for 169 days resulting in accounts of 19% of the region's total mammalian species, including jaguar and ocelot. Data collected in the United States were shared with the U.S. Fish and Wildlife Service, Arizona Game and Fish Department, and Sky Island Alliance; data collected in Mexico were utilized for improving management outcomes of Rancho El Aribabi by the private landowner. These results are especially important considering the low cost of materials, brief study period, and minimal risk to wildlife, allowing for reproducibility within communities, thus increasing the depth and scope of current conservation projects.

**85 Spatially explicit models of peripheral squirrel populations inform management of both invasive and endangered species**

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Oral Presentation

Peripheral populations of species often experience different selective pressures and display population dynamics that vary from the core range. Peripheral populations of invasive squirrels are known to have different demographics than established populations – is the same true for peripheral native and endangered populations? Understanding the interplay between landscape and wildlife population dynamics is necessary for successful management. Spatially explicit population models (SEPM) link landscape parameters with individually based population models through dispersal functions to model species populations. These methods have been applied to leading-edge peripheral populations of invasive eastern gray squirrels (*Sciurus carolinensis*) in Ireland and were able to predict future range expansion under various control scenarios. We show how the lessons learned from the previous gray squirrel studies can shed light on the future of trailing-edge peripheral populations of native species at risk of habitat change from climate change. The Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) is an endangered mountain isolate in Southern Arizona that has been the subject of a long-term monitoring program. We outline the current understanding of the population demographics of this species and detail how we are applying SEPM techniques to model the future of this endangered squirrel in the face of predicted habitat change. The outcomes of these models will allow us to create and carry out informed species and habitat management plans.

**17 Estimating density of American black bears in New Mexico using noninvasive genetic sampling-based spatial capture-recapture methods**

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Oral Presentation

Since 2004, the New Mexico Department of Game and Fish (NMDGF) has estimated the state's black bear population by coupling density estimates with the distribution of primary habitat generated by Costello et al. (2001). Recent advances in non-invasive sampling and mark-recapture methods have prompted the NMDGF to update their density estimates for black bear populations in New Mexico. Five study areas were established in these 3 mountain ranges: the northern (NSC; sampled in 2012) and southern Sangre de Cristo Mountains (SSC; 2013), the Sandia Mountains (2014), and the northern (NSacs) and southern Sacramento Mountains (SSacs; both sampled in 2014). We sampled each population using two concurrent non-invasive genetic sampling methods - hair traps and bear rubs (Woods et al 1999, Kendall et al. 2008). We set 554 hair traps and 117 bear rubs and collected 4,083 hair samples. We identified 725 (367 M; 358 F) individuals; the sex ratio for each study area was ~50%. Our preliminary-density estimates varied within and among mountain ranges, but our results suggest that the density is similar (SSC and SSacs) or higher (NSC, NSacs, and Sandias) than the density estimates previously used by NMDGF. Detection probability (0.000016 - 0.02) was low across all study areas, which affected the precision of our density estimates. Despite sampling difficulties, we were able to produce a relatively precise density estimate for New Mexico black bear populations with levels of precision comparable to estimates of black bear density made elsewhere in the U.S. The NMDGF will couple these density estimates with an updated habitat suitability map to establish harvest levels for responsible management and assured longevity of New Mexico's black bears.

**111 Can elementary-school students understand climate change science and its effects on local wildlife?**

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Poster

Many schools, public in particular, exclude climate change education from their curriculums. I asked can 4th grade children grasp the science behind climate change while connecting it to the impacts is has on local wildlife? I worked with two New Mexico 4th grade classes over two weeks; one class already having learned a fair amount of environmental science, and the other having no recent environmental science background. For the first session in both classes, without giving any background, students were asked to draw and use words to show, "How a change in climate would impact New Mexico wildlife." Most of the drawings showed pandas, penguins, and cats, with not much of a climate component shown. After two weeks of sessions, students were then asked to draw and use words to answer the question again. As indicated from the post-

lesson drawings, every one of the students drew a New Mexican species in its habitat, and could link the enhanced greenhouse effect with why that wildlife species would be imperiled. In this project, a clear majority of the students drew the pika (*Ochotona princeps*) to serve as a New Mexico representational animal impacted by climate change. This suggests its possible use as a local species to teach about climate in the way polar bears (*Ursus maritimus*) play that role on a global scale. My results also suggest that 4th grade students are readily able to understand climate change and its impact on local wildlife.

**46 Flat-tailed Horned Lizard Demographic Monitoring in the Yuma Desert Management Area (2008-2015), Arizona**

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Oral Presentation

The Yuma Desert Management Area (YDMA) represents the majority of the Flat-tailed Horned Lizard's (FTHLs) range in the state of Arizona. Demographic monitoring has been carried out since 2008 on two separate plots in the Yuma Desert Management Area, including one plot on the Bureau of Reclamation and another on the Barry M. Goldwater Range. Monitoring was continued in 2015 with intense 10-day surveys at each plot during the active season of FTHLs. Mark-recapture techniques were carried out using PIT tags (toe clips for juveniles). Data over all eight years were summarized and compared. Adult body condition was calculated separately for each year per plot . We found the average body condition over all eight years was slightly below normal for both plots. Robust design multi-year population models were created using program MARK with eight years of adult FHTL data, estimating survivorship, capture probability, emigration, and immigration. Population size varied from year to year, with a major increase in 2010, a decrease in 2011 and 2012, and an increase from 2014 to 2015 at both plots. The average population rate of change for both plots is greater than one, indicating an overall trend of population growth over the past eight years. Population stability may be determined by a variety of independent or combined factors including changes in seasonal environmental conditions, habitat conditions, predation levels, and unknown factors. Continued long-term demographic monitoring would be beneficial for more reliable assessments of FTHL populations within the YDMA and throughout the species range.

**50 Response in Songbird Abundance to Forest Treatments on Camp Navajo, Arizona**

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Oral Presentation

Prior to Euro-American settlement, ponderosa pine (Pinus ponderosa) dominated forests in the American southwest were subject to low intensity fires occurring every 2-25 years. This fire regime maintained a herbaceous understory beneath clusters of widely-spaced mature trees.

Ponderosa pine forests have been altered considerably since the mid-19th Century due to anthropogenic influences. Beginning in the mid-20th Century, forest management such as thinning and prescribed fire began in various locations in southwestern ponderosa pine forests to decrease the risk of catastrophic wildfires, and to protect towns and cities. The effects of forest treatments on wildlife communities in ponderosa pine forests are of great interest to wildlife biologists and land managers. Specifically, the effects of restoration treatments in ponderosa pine forests on songbirds have been investigated in various locations within southwestern ponderosa pine forests. We've conducted songbird surveys on Camp Navajo since 2001. We analyzed bird detections at the level of feeding and nesting guilds, and created a model that comparing detections against variables such as time since treatment, and treatment type (deferred, burn, burned and thinned). We found that different guilds responded differently to the forest management regime being implemented at Camp Navajo. Some guilds (tree nesters, foliage gleaners, ground gleaners) showed a significant numerical response in the time since treatments took place. Other guilds (hawkers, bark gleaners, and tree nesters) responded to treatment types. Our long-term study suggests that ecological guilds of songbirds respond differently to different treatment activities as well as over different temporal scales.

**18 Resuming a keystone role: the return of black-tailed prairie dogs to Arizona**

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Oral Presentation

The black-tailed prairie dog (BTPD; *Cynomys ludovicianus*) has been commonly described as a keystone species in grassland ecosystems. BTPDs physically alter their environment by burrowing, foraging, and maintaining short vegetation on their colonies, which provides habitat and shelter for other species, creates macropores for water percolation, facilitates soil turnover, provides young nutritious plant shoots for grazers, creates fire breaks in grasslands, and may prevent woody plant encroachment (Archer et al. 1987, Kotliar et al. 1999, Underwood and Van Pelt 2000). Despite their many services, many eradication programs were carried out beginning in the early 1900s. Because of these eradication programs, the BTPD was extirpated from Arizona by 1960 (Underwood and Van Pelt 2000); however, in 2008, the Arizona Game and Fish Department began reestablishing the BTPD to its historical range in southeastern Arizona. What are the effects of the return of a keystone species to an environment after a prolonged absence? The recent reestablishment of the BTPD to southeastern Arizona provided us with a unique opportunity to determine if and how returning the BTPD to the landscape affected the environment, and if their reestablishment could simultaneously manage woody encroachment in the grassland ecosystem. To address our question, we trapped small mammals, sampled soil, and conducted experiments with woody plants on and around 4 recently reestablished BTPD colonies at Las Cienegas National Conservation Area in southeastern Arizona. Reintroduction of BTPD had immediate impacts on the abiotic and biotic components of the desert grassland ecosystem. BTPDs appear to quickly alter soil characteristics and suppress woody plant growth on their colonies, which suggests their rapid resumption of a keystone function. We found higher availability of nutrients, and higher concentrations of several nutrients important for plant growth in soil on burrow mounds. Also, we found that woody plants on BTPD colonies were disturbed at a much higher level than those on colony peripheries or off of colonies, supporting the idea that BTPDs may play a role in preventing

woody encroachment. Finally, we found that prairie dog-induced modifications to soil and structure may also influence biodiversity, specifically small mammal guild composition, soon after reestablishment. Our results show that BTPDs are playing a critical role in several aspects in the maintenance of ecosystem structure and function, and can resume this role almost immediately after reestablishment.

**24 On Overview of the Sovereign Citizen Movement: Keeping You Safe in the Field**

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Oral Presentation

In 2014 rancher Ted Bundy used the language of the sovereign citizen movement as a rallying call, beckoning support from members of the Oath Keepers, the White Mountain Militia, the Praetorian Guard, and other like-minded individuals to join his Bundy militia in a fight against the US Government. Armed militants from Nevada, Idaho, Arizona, California, and other areas responded with a show of force. Last spring a judge's order requiring the Bureau of Land Management to refrain from enforcing its regulations over the Sugar Pine Mine in southwestern Oregon appears to be enough for the assembled antigovernment "Patriots" who have shown up on the scene to declare victory and head for home. And in January, militia took over the Malheur National Wildlife Refuge. This presentation gives you an overview of the sovereign citizen movement and provides examples and information for keeping you safe in the field as a field biologist or law enforcement officer.

**112 Climate anomalies and time modify land-use effects on bird community structure in an urban desert ecosystem**

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Poster

Over the last 15 years, Central Arizona-Phoenix Long-term Ecological Research (CAP LTER) teams have collected data on land-use and bird sightings on 46 sites across the Greater Phoenix Area. We investigated how land-use effects on bird community species richness abundance varied over time. We used General Linear Mixed Models (GLMMs) to with land use and time as crossed fixed effects. Results showed a significant land-use by time interaction on both species richness and abundance, indicating that land-use effects were not consistent over time. Further analyses indicated that show that the magnitude of land use effect sizes on bird abundance were predicted to the occurrence of droughts (as measured by Palmer Drought Severity Index, PDSI), with effect sizes being largest during dry periods one year prior to and during the survey. Land use effect sizes on bird species richness were also influenced by droughts, with larger effects during dry periods one year prior to and wet periods during the survey; however land use effect sizes on bird species richness also increased over time. In fact, a priori planned contrasts indicated that significant differences between land uses were not observed until 2013 and 2014. Thus, variation effects of land use on bird abundance and species richness were related to time-lag and current effects of drought, and land effect use effect size on species richness also is

growing over time. Future work on this project will be to investigate the long-term effects of land use on beta diversity patterns and community structure of bird communities..

### 65 A method for assessing presence of the endangered New Mexico meadow jumping mouse

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Oral Presentation

Recovery efforts for New Mexico meadow jumping mice (*Zapus hudsonius luteus*) require accurate assessments of animal presence and population size. Traditional live-trapping methods increase the cost, risk of trap mortality, and potential for bias with trap-shy subjects. Our objectives were to develop an effective track plate and field guide for the jumping mouse and other species likely to be misidentified as jumping mice. During summer 2015, we obtained prints from rodents captured during a companion live-trapping study conducted at 11 riparian sites on the Apache-Sitgreaves National Forest. We collected tracks for jumping mice, 3 voles (*Microtus* spp.), 2 deer mice (*Peromyscus* spp.), the Mexican woodrat (*Neotoma mexicana*), and the western harvest mouse (*Reithrodontomys megalotis*). Jumping mouse tracks were unique and easily identifiable. We developed 4 track plate designs, selected the most effective (a modified plastic shoe box), and tested it at 9 sites (n = ~1600 track plate nights). Jumping mice were detected at 6 of 9 sites in riparian, ecotone, and upland microhabitats 0 to ~25 m from water. Track plates were more efficient to use (e.g., fewer personnel, less fatigue, lower costs, wider work area) and with no risk of mortality compared to live-trapping; however, live-trapping allows confirmation of species, identification of individuals, and collection of other information (e.g., reproductive status). Track plates seem to be an effective tool to detect and monitor populations, research life history characteristics, and pursue recovery objectives for this endangered species.

### 89 Isotopic evidence links drought stress and bottom-up regulation in a grassland herbivore

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Oral Presentation

Deserts and arid grasslands experience extremes in temperature and moisture availability that create periods of environmental stress and bottom-up regulation of consumer populations within abiotically-driven ecosystems. Gunnison's prairie dog (*Cynomys gunnisoni*) is an herbivore that ranges from desert grasslands to high-montane meadows, and whose populations are limited by

disease factors that are more prevalent within montane habitats. We employed stable isotope analysis to investigate energy assimilation patterns as indicators of bottom-up regulation in arid grassland and montane populations of *C. gunnisoni* during a multi-year drought. Standard ellipse areas of plasma and red blood cell carbon (δ13C) and nitrogen (δ15N) isotope values that represent population-level foraging niche widths declined during years and seasons of drought stress at both study sites. Prairie dogs at the montane site, but not the desert grassland site, maintained seasonal shifts in dietary niche width corresponding to periods of favorable growth conditions for the more highly-nutritious plants utilizing the C3 photosynthetic pathway. Production of offspring was strongly correlated with *C. gunnisoni* δ13C values in metabolically active tissues (plasma and red blood cells), but not with δ13C values in adipose tissues used for long-term energy storage, or with foraging niche widths. These findings indicate that drought conditions constrain use of foraging resources by *C. gunnisoni*, and that assimilation of energy from C3 plants is associated with increased reproductive output. The link between preferred forage availability and demographic parameters highlights the role of bottom-up regulation within this reportedly disease-limited species..

**113 Mammalian Inventory of New Mexico's Organ Mountains: Centerpiece of the Organ Mountains-Desert Peaks National Monument**

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Poster

The Organ Mountains, which are located adjacent to Las Cruces in Dona Ana County, are a prominent and iconic feature of southern New Mexico's desert landscapes. Most of the mountain range is public land administered by the Bureau of Land Management, and it serves as a focal point of the Organ Mountains-Desert Peaks National Monument, which was established in 2014. Despite its proximity to a major city and university (New Mexico State University), the mammal fauna of the mountain range has been poorly documented. Yet, biodiversity of the mountain range is likely to be high compared to the surrounding Chihuahuan Desert floor, given that peaks approach 9,000 ft and harbor an array of unique habitat types. Thus, the purpose of this study was document the mammal fauna of the Organ Mountains in order to serve as a reference for management and outreach education efforts. We reviewed museum records and literature, which confirmed occurrence of 62 species of mammals in 12 families and 7 orders. In addition, we used remote cameras to gain more understanding about occurrence and habitat use of the 13 species of carnivores documented from the range (three other carnivores are extirpated). Preliminary results from 30 sites along the northeastern and northwestern flanks of the range captured four species, including grey fox (*Urocyon cinereoargenteus*), ringtail (*Bassariscus astutus*), spotted skunk (*Spilogale gracilis*), and striped skunk (*Mephitis mephitis*).

**99 Multiscale analysis of Mexican spotted owl breeding site selectivity vs adjusted reproduction indexes (ARPI)**

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Oral Presentation

The Mexican spotted owl (*Strix occidentalis lucida*) is listed as a threatened species and restoring and maintaining nesting habitat is the dominant conservation action for recovery. However, current methods for monitoring and assessing Mexican spotted owl nesting habitat at multiple scales over large landscapes in real time are poorly developed. Further, current evidence indicates that owl reproductive success is mediated by climate rather than habitat. To address these topics we quantified levels of owl nesting habitat selectivity based off the used and available proportions and subsequently compared owl selectivity to an adjusted reproduction index (ARPI) for individual owl territories on tribal lands. We clipped Moderate Resolution Imaging Spectroradiometer (MODIS) satellite images over a 13 year period to our region of interest to assess Mexican spotted owl habitat using phenoclasses, which were phenologically self-similar clusters of pixels. We clustered Mexican spotted owl nesting sites according to their phenological signatures at two spatial scales that approximately represented the Protected Activity Center (PAC) and core scale. Mexican spotted owl nest sites clustered into 7 distinct classes at the PAC scale and 6 distinct classes at the core scale. We built habitat suitability maps that delineated PAC habitat and core habitat based off each pixel's adjacent composition of phenoclasses. Results indicate no relationship between owl habitat selectivity and ARPI, possibly indicating that the success of individual breeding owl pairs cannot be attributed to phenological characteristics within the nest vicinity.

## 114 Anuran species inventory and *Batrachochytrium dendrobatidis* (chytrid) survey along the Wild and Scenic section of the Rio Chama and the Rio Grande in Albuquerque

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Poster

Frogs, as water quality indicators and in worldwide decline, are an important taxa of ecological study. Chytrid (*Batrachochytrium dendrobatidis*) fungus has been decimating amphibian populations worldwide. There is limited knowledge about this fungus in northern New Mexico. Knowing whether or not it is present will have important management implications for amphibian survival and reintroduction efforts of presently extirpated anuran species. We conducted over 64 hours of both randomized transect and selective site surveys for frogs along the Wild and Scenic section of the Rio Chama and the Rio Grande in Albuquerque. We actively captured frogs with dip nets as well as conducted night-time frog auditory surveys. We identified two species at each studied area, with *Anaxyrus woodhousii*, detected at both sites, *Lithobates pipiens* along the Chama, and *Lithobates catesbeianus* along the Rio Grande. A total of 29 animals were swabbed for chytrid presence and PCR analysis detected no chytrid from the swab samples. Our work provides a baseline of detected anuran species and chytrid status at two riparian areas of high human impact. Because the two locations are along river sections used for both irrigation and drinking water, and amphibian health can reflect water quality conditions, our research also has human health implications.

**95 An Evaluation of Off-Highway Vehicle Influence on Space Use by Kit Foxes in Arizona**

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Oral Presentation

Off-highway vehicle (OHV) use is popular for outdoor recreation across the United States. A limited number of previous studies have documented negative impacts of OHV recreation to wildlife species. However, none evaluated the impact of OHV activity on kit fox (*Vulpes macrotis*) intensity of space use. To evaluate the potential impacts of OHV activity to kit fox space use, we conducted a study from 2010-2013 in two areas of the Sonoran Desert in central Arizona. We used empirical data to determine the importance of OHV activity to kit fox space use, relative to other measured environmental variables. We also used an experimental approach to evaluate whether kit fox space use shifted when OHV use was increased. We monitored 22 collared individuals and used linear mixed models and an information-theoretic approach to develop models of intensity of space use for kit foxes. We also experimentally increased OHV activity in 2013 and used metrics of joint space use to evaluate whether kit foxes shifted space use in response to experimentally increased OHV activity. We found road density, our index of OHV activity, to be the most important predictor of space use intensity, relative to other measured environmental variables. Kit fox space use intensity was negatively associated with OHV activity during the winter season (Oct-Mar). Our results suggest that OHV disturbance can negatively influence kit fox space use.

**115 Population Dynamics in Fragmented Habitats: Is the Pika Population in Bodie State Historic Park a True Metapopulation?**

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Poster

The metapopulation concept has become an important theoretical construct guiding management of many wildlife and fish populations. However, as classically defined, true metapopulations appear to be rare. A population of American pikas (*Ochotona princeps*) inhabiting an anthropogenic landscape in the ghost mining town of Bodie, CA have historically been interpreted as a true metapopulation. This landscape comprises discrete habitable talus (ore dumps) surrounded by Great Basin sage scrub. Although a 20-year dataset shows that the ore dumps experience repeated cycles of extinction and recolonization, the interpretation as metapopulation dynamics has been challenged by two competing alternatives. One suggests that large ore dumps act as mainlands, making the landscape a classical MacArthur-Wilson island-mainland system. The second alternative, due to Clinchy in 2002, proposes an "extinction disk" model, in which patch occupancy dynamics are driven by spatially correlated extinctions. Here we test the extinction disk model by comparing the 20-year Bodie to results generated by a

computational model of the extinction disk hypothesis. We find that measures applied in the past may be unable to distinguish the two hypotheses, and propose new measures based on well-established spatial statistical procedures. Our models and statistics can be adjusted and parameterized to fit other fragmented populations to identify or exclude metapopulation dynamics. With habitat fragmentation increasing globally, robust models of the type we study here can help biologists and managers predict population-level responses to increasing isolation caused by fragmentation.

**70 Top-Down and Bottom-Up Forces on Central New Mexico Mule Deer**

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Oral Presentation

Since the 1960s, mule deer (*Odocoileus hemionus*) have been declining throughout the western United States, including New Mexico. Predation and nutrition are two major ecological mechanisms identified as potential limiting factors in western deer populations. In New Mexico, little research has been conducted to specifically examine how predation and nutrition concurrently impact mule deer including their relative influence on vital rates such as survival and reproduction, both of which ultimately affect population growth. Our goal is to provide further insight into mechanisms underlying the state-wide mule deer decline by examining relationships spanning multiple trophic levels and their relative impacts on deer population dynamics. More specifically, this study will investigate the effects of top-down (predation) and bottom-up (nutrition) forcing on mule deer productivity by conducting forage biomass surveys, estimates of nutritional content of key forage species, estimates of diet quality via fecal indices, determining mountain lion (*Puma concolor*) predation rates and utilizing deer survival, pregnancy rates, juvenile recruitment and habitat selection data. Healthy ecosystems depend on interactions between species from various trophic levels. Mule deer play a critical play role in maintaining these biological processes that exist between producers and consumers. Additional knowledge about the relationships between deer, nutrition, and predation will allow agencies and conservation groups to better understand and more holistically manage ecosystems in order to promote sustainable mule deer populations in New Mexico.

**90 Pre-dispersal exploratory movements - and implications for dispersal in fragmented landscapes**

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Oral Presentation

Natal dispersal in many species is preceded by exploratory movements which are highly variable among species and individuals. I reviewed published empirical and simulation studies that investigated the correlations between exploratory movements and dispersal distance, habitat use during exploratory movements, and differences between male and female exploratory and

dispersal behaviors. A large number of papers report on the occurrence, timing, and sexual variation in exploratory behavior. Within the last decade, more detailed studies have been conducted, indicating that exploration may allow animals to assess habitat quality, territory vacancies, and costs of dispersal. They may also be a strategy to cope with a temporary failure of resources, or present failed dispersal events. In heterogeneous landscapes with high spatial variation in habitat quality, exploration has been shown to be beneficial for detecting quality habitats. In homogeneous landscapes, exploration allows short-distance dispersers to locate vacant territories. Long-distance dispersers may benefit from exploratory movement by learning about the costs of dispersal movements. Several studies have found that during exploratory movements animals readily use moderately unsuitable habitat, and only avoid the most unsuitable conditions. I will discuss the implications of increasing habitat fragmentation on exploratory movements and subsequent dispersal.

**87 What Everyone Wants to Know About Permits!**

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Oral Presentation

When preparing for a project involving any wildlife in Arizona, it is important to understand what is needed to get a project started. The field researcher must prepare everything carefully, including funding, land access, and if required, obtaining both federal and state permits and/or licenses (Even individuals simply observing wildlife need to understand what actions are legally unacceptable, and whether a special license is required). Permits are important for ensuring wildlife protection, preventing unnecessary stress on a wildlife population from over collecting or duplicating an activity, and protecting public safety. Understanding the process for obtaining permits is vital to a successful project and can sometimes be cumbersome to most people. This paper will explain what permits and/or licenses are legally required for scientific collecting in Arizona and the reasons for these requirements. It will also describe the appropriate materials and information needed prior to your project and the procedures to follow when applying with the state.

**51 Monitoring of Sonoran Desert Tortoises on DOD facilities in Arizona**

LEAVITT, DANIEL.

Oral Presentation

Monitoring of the Sonoran Desert Tortoise has been conducted with two distinct techniques on Department of Defense lands in Arizona. Both radio-telemetry and occupancy survey monitoring have been employed on Department of Defense lands but each provide very different results. Here I will summarize the results of occupancy monitoring and radio telemetry in light of what they may tell us about the status of Sonoran Desert Tortoises. Occupancy monitoring can provide basic information regarding the geographic distribution of Sonoran Desert Tortoises to managers charged with land or resource management. Of the 4 locations where occupancy surveys have been conducted on Department of Defense lands most were managed by the Arizona Army National Guard. Radio-telemetry for Sonoran Desert Tortoises has been conducted on three locations managed by the Department of Defense to understand these animals interact with their landscape. Combining the recent statewide occupancy assessments with radio-

telemetry data has resulted in a more refined understanding of the status of Sonoran Desert Tortoises across a broad range of management types and practices.

### 93 Animal migration altered by cheatgrass and concomitant shifts of fire and phenology: The Kaibab mule deer example

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Oral Presentation

Seasonal migration is a strategy that has enabled animals to increase their survival and fecundity by exploiting spatiotemporal resource heterogeneity and decreasing predation risk. But migration patterns of many migratory populations have been observed to shift in the past few decades. We describe a temporal acceleration of the spring migration by 5-6 weeks and a 29% spatial expansion of the winter range over the past 30 years of mule deer (*Odocoileus hemionus*) on the Kaibab Plateau of northern Arizona, USA. We evaluate three hypotheses as potential ecological drivers underlying the observed spatial and temporal shifts in deer movement. Neither population dynamics nor shifts in climate appear to directly explain the alterations in the migration patterns we observed. The hypothesis that the forage resource availability on the winter range was insufficient to sustain the current deer population is supported by an apparent decline in the quality of the forage on the winter range in recent years necessitating the movement of individuals to areas with more abundant resources. Our results suggest the cheatgrass invasion and the establishment of novel fire regimes have altered the migration patterns of the Kaibab mule deer herd. Understanding the nature of the relevant interactions of fire management, displacement of native forbs and perennial grasses, and ungulate habitat selection is the first step to understanding how migratory strategies will continue to evolve in the face of global change enabling the prediction of future trends and development of effective management approaches to encourage new growth of native forage species.

### 15 Evaluating the complex and dynamic facilitative effects of tamarisk obligate insects for two native riparian warblers

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Oral Presentation

Tamarisk (*Tamarix* spp.) is an invasive tree argued to have positive and negative effects on native birds. Three tamarisk obligate insects (tamarisk leafhoppers (Opsius stactogalus), tamarisk leaf beetles ("TLBs," *Diorhabda carinulata*) and tamarisk weevils (*Coniatus splendidulus*)) may be prey for birds and therefore increase the value of tamarisk. Birds likely respond differently to each tamarisk obligate insect and understanding these responses are critical for management. We hypothesized: 1) The value of tamarisk to birds, in terms of food availability, would differ depending upon which tamarisk obligate insects were present in the diet and 2) Prey would be

eaten in proportion to their relative abundance in the environment. We used sweep nets to estimate arthropod abundance. We identified arthropods from feces of Lucy's (*Vermivora luciae*) and yellow (*Setophaga petechia*) warblers collected from tamarisk and tamarisk/native mixed habitats. Tamarisk obligates comprised ~50 percent of warbler diets in tamarisk habitat. Tamarisk obligates were eaten significantly more than non-tamarisk obligates in tamarisk/native habitats. We found no support that birds selected tamarisk obligates in proportion to our arthropod abundance estimates. It has been proposed that TLBs would facilitate native birds by providing food, but we found little support for this hypothesis. Our results showed that Lucy's and yellow warblers forage most for tamarisk weevils, the least abundant tamarisk-obligate in the system. Our results suggest that the value of invaded habitats for two native warblers are dynamic and can change over time with subsequent invasions. In terms of food, TLBs probably offer little value for native warblers. However, if tamarisk weevils are introduced, the value of tamarisk may change, and in-turn, facilitate native warblers. We recommend land managers identify areas with tamarisk weevils to better allocate limited restoration resources and maximize conservation of native habitats and species.

**63 Habitat use of the San Bernardino flying squirrel in a post fire landscape**

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Oral Presentation

Fire is a common factor that affects species worldwide and its occurrence is expected to increase with climate change. The San Bernardino Mountains of Southern California have experienced a significant number of fire events in recent years. The San Bernardino flying squirrel (*Glaucomys sabrinus californicus*) is a nocturnal mycophagist that is found in high elevation forests of this mountain range. In recent years, population numbers have decreased to the extent of local extirpation from the nearby San Jacinto Mountains and has led to the species currently being under review for protection under the federal Endangered Species Act. Our study focuses on the area affected by the 2007 Grass Valley Fire near Lake Arrowhead, CA, during which 366 ha were burned, much of which was documented as habitat for the San Bernardino flying squirrel. This recent fire has led to a landscape containing patches ranging from heavily burned to intact forest. We used noninvasive methods, including hair tubes and remote sensor cameras, to assess presence and current occupancy by San Bernardino flying squirrels across varying burn severities and habitat types in the study area. Analysis of camera trap photos shows that flying squirrels occur frequently in areas with low to moderate burn severities. By using non-invasive methods to assess occupancy we aim to safely and accurately estimate the presence of a sensitive species, and determine to what extent its habitat use is affected by factors such as fire.

**116 Assessment of Raptor Migration Corridors in Arizona's Sky Islands**

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Poster

During the fall and spring, raptors are known to use leading lines (e.g. coastlines, rivers, mountain ranges) to help guide their migration to and from wintering and breeding grounds. Mountain ranges are often leading lines because they create updrafts and thermals, and rivers provide visual pathways. The mountain ranges and rivers in central and southeastern Arizona are part of a known flyway for migrating raptors. However, the potential concentration of raptors along leading lines in central and southeastern Arizona could present conflicts with the placement of wind turbines. Wind turbines are often placed in the same locations migrating raptors use because of updrafts and wind generation. Our objective was to assess the use of mountains and rivers in central and southeastern Arizona by migrating raptors. We counted migrating raptors in the spring and fall for two years at 10 paired count stations (eight pairs of stations were in mountains with one station of each pair located as high as possible given road access and the other in the valley; two paired stations were along rivers with one station located on the river and the other away from the river). Counts at each pair were conducted simultaneously and began two hours after sunrise and continued for five consecutive hours. Raptors flying over-head were identified and recorded along with flight direction, flight height, and distance from observer. During 478.75 observation hours, 1,002 raptors were counted (2.1 raptors/hour). Counts of raptors (at high mountain stations and river stations were slightly higher (2.6 raptors/hour) than were counts low stations and off river stations (1.6 raptors/hour). The numbers of migrating raptors we counted are low relative to counts of raptors during migration in other sites in the west, which range from 3.9 to 77.3 raptors/hour. Our data suggest the mountain ranges and rivers in central and southeastern Arizona are not a major migration pathway for raptors.

**20 Transient connectivity windows: Impacts of temporary and permanent isolated water resources in the Sonoran Desert on connectivity, isolation, and wildlife management strategies**

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Oral Presentation

Desert waters are rare resources that act as literal oases to support a number of endemic, rare, or sensitive species, so water supplementation is a commonly used wildlife-management tool in arid and semi-arid regions. However, such supplementation may also have unintended negative consequences. A network of 82 natural waters (67 charcos, 15 natural tinajas) on the U.S. Air Force's Barry M. Goldwater Range East (BMGR-E) and Bureau of Land Management (BLM) lands in the Sonoran Desert of Arizona has been supplemented with 35 anthropogenic waters (13 modified tinajas and 22 artificial catchments, i.e. "guzzlers") to support wildlife with various water-use strategies and dispersal capabilities. We used graph theory and circuit theory to explore the influence of highly ephemeral (but abundant) charcos and artificially permanent guzzlers on structural and functional connectivity in the BMGR-E/BLM lands. Guzzlers are important wildlife management tools and appear to play an outsized role in countering the natural isolation of Sonoran Desert waters. However, this reduction in isolation could harbor

unintended consequences by providing low-suitability habitat for native amphibians and by facilitating the spread of invasive species and zoonotic diseases. Circuit theory simulations helped illustrate landscape influence on animal movements between waterbodies. Simulated removal of waters allowed us to generate a prioritized list of waters found to be consistently important for connectivity conservation for wildlife (large and small) on BMGR-E and adjacent BLM lands. Such an approach could be adopted in situations where quantitative assessments of connectivity among habitat patches and management options are needed.

**103 Population genetic diversity and structuring in yellow-billed cuckoos**

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Oral Presentation

The western distinct population segment of yellow-billed cuckoo (*Coccyzus americanus*), a long-distance Neotropical migrant and obligate riparian breeding bird, was recently listed as threatened due to widespread loss and degradation of riparian forest. Habitat fragmentation may have less impacts on dispersal patterns of long-distance migratory species compared to resident species, however previous genetic research on yellow-billed cuckoos suggests local structuring among isolated western breeding sites, requiring further analysis. There is also interest in using informative genetic markers to better assess differentiation between western and eastern yellow-billed cuckoos. I compared 14 polymorphic microsatellite loci among seven separate breeding sites in the west, and between western and eastern samples (n = 175 total). I found no evidence of genetic structuring, suggesting sufficient dispersal is occurring to maintain gene flow among these groups. I also measured lower than expected heterozygosity across the range, possibly due to increased inbreeding within small populations, though the results are clouded by a high estimated rate of null alleles upwardly biasing homozygosity. To test scoring accuracy, I compared microsatellites and mitochondrial sequences in six family groups sampled from high-density restoration sites, calculating a scoring error of 2.12%, 1.21% explained by null alleles. I also found a relatively high rate of conspecific nest parasitism within the family groups. Increased restoration of large patches of riparian forest may help to recover this declining population.

**62 Climate effects in the cache behavior of the Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*)**

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Oral Presentation

Behavioral plasticity and the capability to deal with both natural and anthropogenic variation in the environment are important characteristics to the persistence of a species in a changing world. The understanding of how a species copes with environmental variation and levels of tolerance for variation are extremely useful to predict the consequences of future change, such global warming, and to guide conservation actions. Considering that food caching is a behavior essential for the winter survival of species in temperate habitats, the objective of our study is to evaluate the effect of climate on the cache behavior of the endangered Mont Graham Red Squirrel (*Tamiasciurus hudsonicus grahamensis*). To achieve this objective, we are monitoring micro-climate variables, including the temperature and moisture of air, soil, scale piles and pits, of 34 middens, as well as the general climate of the study area, in the Pinaleño Mountains. Not surprisingly, temperature decreases with elevation on Mt. Graham; however, how do squirrels respond to the changes at the level of the midden. The food caching effort of the resident squirrels is being estimated by the number of pits excavated by the animals to cache cones. GIS modeling techniques will be used to isolate the effect of climate and topography variation in the caching behavior. The results will be useful to predict the possible effects of climate change or El Niño in the population of this endangered subspecies.

**36 Towards an increased understanding of space use and poaching risk in rhinos: vegetation mapping in the lowveld of South Africa**

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Oral Presentation

South Africa harbors 82% of Africa's rhino population, and is disproportionately impacted by poaching, with 75% of total rhinos poached in Africa since 2006, and African rhino populations are increasingly confined to protected areas. Balule Nature Reserve (BNR) comprises 37,977 ha and is part of the Kruger Associated Private Nature Reserves (APNR). Nineteen black rhinos (Diceros bicornis) and several resident white rhinos (Ceratotherium simum) were fitted with VHF transmitters and tracked weekly. Rhino conservation efforts require understanding resource selection, space use, and seasonal energy budgets, yet current reserve-wide vegetation data are lacking within BNR. Our goals were to 1) develop a classified vegetation land cover model for BNR and 2) model rhino space use, resource selection, and poaching risk incorporating vegetation and other ecological variables. We used Landsat 8 imagery to develop a classified vegetation model, identifying 5 cloud-free scenes between 15 October 2014 and 15 October 2015. We generated a normalized-difference vegetation index (NDVI) composite as the basis for unsupervised classification yielding 10, 15, and 20 possible vegetation classes within a 30 km buffer around BNR. To validate and refine our model, we identified a stratified random subset of Landsat pixel centroids to visit in situ. In November and December 2015 we assessed woody vegetation community composition and structure at 130 random locations, resulting in 80

unique tree species across 7 dominant classes within BNR. Herein we assess the efficacy of our vegetation mapping and assess models of rhino space use and habitat selection.

**14 Use of Conservation Reserve Program (CRP) habitat by lesser prairie-chicken in eastern New Mexico**

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Oral Presentation

The lesser prairie-chicken (*Typanuchus pallidicinctus*) is a species of conservation concern. Research in Kansas has shown that Conservation Reserve Program (CRP) grasslands are used by lesser prairie-chickens for breeding, nesting, and brood rearing. Lesser prairie-chicken use of CRP grasslands in New Mexico has not been well documented and there is disagreement as to its importance in their life history. Our objective was to determine if and why lesser prairie-chickens use CRP habitat in eastern New Mexico. We captured and radio collared lesser prairie-chickens in the spring of 2014 and 2015 and monitored their movements throughout the breeding and winter seasons in relation to CRP and other habitat types. During the 2014 breeding season, 76% of all bird use points fell out in shinnery oak prairie (*Quercus havardii*) while it only comprised 44% of the total available habitat. Grassland habitats comprised 42% of the available habitat, but only contained 17% of all used locations. During the 2014 nonbreeding season, 55% of all bird use points fell out in shinnery oak prairie and grassland contained 41% of all used locations revealing an increased use of grassland dominated habitats during the nonbreeding season. Although CRP is used by lesser prairie-chickens variably across seasons, further habitat improvement efforts for this species in eastern New Mexico should consider switching focus from CRP and concentrate on conservation of native shinnery oak prairie.

**101 First- through fourth-year dispersal of golden eagles from natal areas in the Colorado Plateau Region of the Southwestern United States**

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Oral Presentation

Knowledge of age-specific dispersal by Golden Eagles (Aquila chrysaetos) from natal areas is needed to help manage the species in North America. During 2010-2015, we used satellite telemetry to document pre-adult dispersal by Golden Eagles from natal areas across the Colorado Plateau Region of the southwestern United States. Here we report on (1) first-year dispersal timing, distance, and age, sex, and area influences; and (2) relationships between first-year patterns and those of second through fourth years. Fifty-six Golden Eagles tagged at age ~55 days during 2010-2014 and that subsequently dispersed yielded hourly ±20-m locations for ≥6 months. Most (>75%) eagles dispersed from natal areas during October-early December. By the subsequent early spring, 70% were within 120 km of natal areas and 25% had moved farther; most that dispersed >500 km died within their first year. We found no relationship between dispersal date and sex or age, though long-distance dispersers left natal areas earlier. Eagles from the more arid part of the study area dispersed greater distances in their first year of life. Overlap of second- and third-year, early spring home ranges (HRs; 95% minimum convex polygon) with first-year HRs was 27% and 71%, respectively. Distances between centroids of natal areas and of early spring HRs differed little between first and second or third years. Our findings suggest first-year dispersal patterns strongly determine spatial patterns in subsequent pre-adult years. Most eagles stayed within natal landscapes, indicating such areas are critical habitat for more than just breeding pairs.

**117 Northward summer migration by non-breeding golden eagles from the southwestern United States**

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Poster

Other than wanderings by some non-breeding individuals, golden eagles (Aquila chrysaetos) in the contiguous United States generally are thought to be year-round residents. Fifty-one fledgling Golden Eagles that we tagged with satellite transmitters in the Southwest's Four Corners region during 2010-2014 survived >1 year. Eighteen (36%) of the eagles abruptly moved northward 370-1240 km from areas near (<100 km) their natal sites during late spring, when 12-14 months old. We documented 33 migration cycles including up to five consecutive annual migrations by individual eagles. Eagles typically settled in northerly ranges in May and remained as late as November, then migrated back to natal latitudes, generally following the same routes used for their northward spring migrations. Migrations usually were completed in 2-8 days, but stopover areas were used by some eagles during spring migrations. Eagles that migrated >1 year showed strong fidelity to summer range areas. Summer ranges were located mainly in Wyoming and adjoining areas. Our data suggest that, from May to September, a substantial proportion of non-breeding golden eagles from the southwestern United States

migrate to and reside in more northerly regions. This is the first documentation of a northward summer migration of golden eagles in North America and has implications for population mixing, survey protocols, and managing anthropomorphic threats to the species.

### 88 Habitat suitability model of American hog-nosed skunk in Grand Canyon National Park

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Oral Presentation

Recent sightings of American hog-nosed skunk (*Conepatus leuconotus*) in Grand Canyon National Park have the potential to extend the species' northernmost range in Arizona. Continued studies of the nocturnal insectivore within this deep canyon would benefit from the use of a habitat model. This model was constructed in accordance with the standards for the development of Habitat Suitability Index Models set out in the US Fish and Wildlife Service's Ecological Services Manual. This entailed a literature review of species accounts, general characteristics, spatial analyses, and technical conservation reports; all the while focusing on gathering life requisites to model the skunk's habitat. The variables include slope, vegetation community, tree canopy cover, and topographic position index. This habitat model is structured in a way that allows for the calculation of a multiple-criteria analysis. Presumed skunk sign recorded in the field was later positively identified by an expert, georeferenced, and then plotted for comparison revealing an accuracy to within 50m from an area of high suitability. More extensive field verification is warranted to confirm the accuracy of the model and its variables. Overall results revealed a rather diverse range of suitable habitats along drainage corridors and upland terraces. However, the vast majority of habitat high in suitability is found within the higher elevations of the Kaibab Formation. This begs the question of species occurrence in this deep canyon, and its role as refugium for the northward migration of species in a changing climate.

### 59 Plagued by epidemics: how cats, woodrats and human debris make the case for a one health approach in Arizona

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Oral Presentation

Zoonotic disease outbreaks have been a threat to human and animal health for centuries. Although scientists have long recognized the interactions of diseases in humans and animals, the

two disciplines have remained separate for much of history. Recent outbreaks of Ebola, highly pathogenic avian/swine influenza, Rift Valley Fever, Middle East Respiratory Syndrome and Severe Acute Respiratory Syndrome, however, have caused health professionals from separate disciplines to recognize the need to start collaborating at a local, national and global level. The "one health" approach is a strategy that incorporates multiple disciplines to achieve optimal health for humans, animals and the environment. This approach was recently used in the rural community of Jerome, Arizona where an outbreak of plague (*Yersinia pestis*) infected domestic cats (*Felis catus*) and White-throated woodrats (*Neotoma albigula*). The outbreak involved six cats being presented to local veterinarians with symptoms suspicious of plague; two were laboratory confirmed positive with plague. Local veterinarians and professionals from multiple agencies/universities responded to this event by conducting an environmental investigation to determine further human and animal risk. Our objective was to assess the outbreak, provide information to the community and prevent the spread of the disease. This resulted in 1 freshly deceased woodrat being collected, necropsied and tested, 5 fleas being collected and tested, 47 home visits in the community with 23 contacts to disperse information and vector control with Delta Dust being used around PVC pipes in the community. The purpose of this presentation is to provide an example of how the "one health" approach has successfully been used and to provide recommendations for future events.

**44 Investigating Bat Actinobacterial Microbiota and Natural Defenses against White-nose Syndrome**

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Oral Presentation

Recent studies have shown that mammals, including humans, have a natural external microbial community that acts as a first line of defense against pathogens. We know little about this potential defense in bats and its effectiveness against *Pseudogymnoascus destructans*, the causative agent of white-nose syndrome (WNS). Our investigations of bat microbiota have revealed that gram-positive Actinobacteria are found on many bat species in Arizona and New Mexico, especially on cave-caught bats. Actinobacteria are one of the most prolific producers of secondary metabolites, such as antifungals, and may represent a natural defense system for some bat species against P. destructans. We cultured external Actinobacteria from bats to test for the production of antifungals that are effective against P. destructans using a bi-layer method in the laboratory in which the Actinobacteria is grown on R2A media, followed by a second layer of fungal medium inoculated with a lawn of *P. destructans*. To date, 27 isolates inhibited P. destructans; 22 of which were Streptomyces spp., one was *Rhodococcus rhodochrous*, one *Dermacoccus* spp. and one a *Stretosporangium* spp. Understanding the antifungal potential of external microbiota on bats will help identify potential WNS management tools. Also,

investigations of microbiota, in particular Actinobacteria, give us insight into what management strategies are likely to be successful. Testing microbiota interactions will provide added insight into potential implications of different management strategies. USGS: This information is preliminary and is subject to revision.

### 33 Functional genomics of the endangered Florida panther

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Oral Presentation

The endangered Florida panther (*Puma concolor coryi*) was once distributed across much of the southeastern United States; it currently only persists in reduced patches of suitable habitat in South Florida. Inbreeding—documented in the early 1990s within the small, remnant panther population of 20-30 individuals—may have led to the expression of several deleterious recessive traits (e.g., atrial septal defects, cryptorchidism, poor sperm quality, and low testosterone levels). In 1995, eight female pumas from Texas were introduced into habitat occupied by Florida panthers as part of a genetic restoration program implemented to reverse trends associated with inbreeding depression. The breeding success of five of these eight females helped increase the population size to ~140 panthers by 2015. Even though several studies suggest that neutral genetic diversity has doubled and fitness has significantly increased in Florida panthers, the impact of genetic restoration on the functional (i.e., coding) genetic diversity of panthers remains undetermined. In this study, we used whole-genome sequencing in canonical Florida panthers and Texas pumas to assess functional differences between both populations. We also explored possible local adaptations in canonical Florida panthers and determined the fate (selection vs. drift) of introduced genetic variation in admixed Florida panthers. Results derived from this study will be used to optimize efforts to manage and recover the endangered Florida panther.

### 66 Wolves of the rodent world: Species differences in grasshopper mouse howls and prospects for automated monitoring of an indicator species

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Oral Presentation

Grasshopper mice (*genus Onychomys*) are carnivorous rodents that maintain large territories (> 4 ha) throughout the desert Southwest. As predators high on the trophic scale and dependent on large, contiguous tracts of land, grasshopper mice are ideal umbrella species. As a consequence of their lifestyle, both males and females produce loud advertisement vocalizations to facilitate mate recognition and spacing over long distances. In this study, we captured and recorded Northern (*O. leucogaster*), Southern (*O. torridus*), and Chihuahuan (*O. arenicola*) grasshopper mice in the Bootheel of New Mexico, the only region where all three species co-occur

(n=15/sex/species). Within species, we found no sex differences in call characters. However, fundamental frequency differed significantly among species. In accordance with principles of acoustic allometry, the largest species (*O. leucogaster*) produced the lowest frequencies (34 g; 11.6 kHz), followed by *O. torridus* (29 g; 13.5 kHz) and *O. arenicola* (22 g; 14.9 kHz). Preliminary studies using automated recorders suggest that calls are relatively easy to detect and identify, thus allowing for efficient remote censusing over large spatial scales. Land managers interested in monitoring the integrity of desert ecosystems might consider the addition of howling mice to attract public support for management and conservation initiatives.

**68 Detection rates during surveys of the endangered New Mexico meadow jumping mouse**

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Oral Presentation

The New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) is an endangered subspecies endemic to riparian areas in the American Southwest. Recent surveys attempted to determine current distribution of the jumping mouse across its historic range, but did not explicitly consider the influence of imperfect detection. Additionally, recommendations are needed for how to maximize detection rates for jumping mouse surveys. Occupancy modeling is a statistical technique that uses repeated surveys at the same site to calculate detection probability. We evaluated data from previous jumping mouse surveys using occupancy modeling to examine how detection rates varied based on site characteristics and different sampling protocols. We also compared detection rates among species by comparing occupancy models with no covariates for each species. The best model for detection probability contained all site and sampling design variables, but did not include covariates describing interactions with other small mammal species. Detection rates increased with increasing number of traps deployed per trap line and for observers who were experienced mammalogists. Detection rates were highest in the White Mountains and lowest in the Sacramento and San Juan Mountains. Using the naïve model, overall average detection probability per trap line (mean 60 traps) per night was 37% ± 5% for Z. *h. luteus*, which was relatively high and only exceeded by voles (*Microtus* spp.), deer mice (*Peromyscus* spp.), and ermines (*Mustela erminea*). Surveyors can increase detection rates by utilizing experienced mammalogists and deploying more traps per night, while recognizing that increased effort may be needed depending on region.

**39 Presence-only modelling reveals potential major shifts in suitable climatic niches for Western North American bats**

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Oral Presentation

Climate change is affecting the distribution and abundance of numerous organisms. Species with narrow ecological niches may be more affected than generalists, and while some species may benefit by expanding ranges, others, especially those occupying cooler biogeographic or restricted ranges, could go extinct. We used presence-only modelling to determine how climate change may affect the distribution and community composition of 18 bat species with the center of their ranges in western North America, 17 of which occur in Arizona and New Mexico. We used Maxent modelling algorithms, 5,312 species occurrence records, and climate data from Worldclim to project changes in suitable climate niches over the next 100 years at three different greenhouse gas (GHG) scenarios or "Resource Concentration Pathways" (RCP's) derived by the International Panel on Climate Change; from RCP 2.6, moderate, to RCP 8.5, severe. Species diversity and suitable climatic niche declined significantly with increasing GHG emissions, especially at higher altitudes and latitudes. The average range shift was approximately 180 km northwest under RCP 2.6 and 350 km under RCP 8.5. As predicted, suitable climactic space shifted up in elevation and latitude. In Arizona and New Mexico, slightly more than half of the species showed a contraction of suitable climate niche at all RCP's. *Myotis thysanodes* and *Antrozous pallidus* lost more than 50% of their suitable climate niche and *Corynorhinus townsendii* and *Macrotus californicus* expanded by more than 25%. These results will be used to inform climate adaptation strategies to conserve bat species most affected by climate change.

**119 Human encounters with rattlesnakes in and around Phoenix, Arizona**

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Poster

Expanding residential development in formerly wild areas is escalating the frequency of human and wildlife encounters. More often than not, the problem animals are either relocated or killed by the homeowners. Possessing powerful venom, rattlesnake encounters in neighborhoods can and should raise concerns, especially around children and the elderly. At least seven rattlesnake species are known to inhabit Phoenix, AZ, and surrounding suburbs. Because rattlesnake abundance and diversity is so high in these areas, human encounters are inevitable. To identify rattlesnake hot spots, we used rattlesnake nuisance removal records from Rattlesnake Solutions LLC from 2012 to 2014 and ArcGIS 10.2.2. Between 2012 and 2014, a total of 511 rattlesnakes were removed, with hotspots located at the northeast edge of the city. Moreover, we found the development of previously shrubby areas into urban neighborhoods experienced the most rattlesnake removals, supporting the notion that more rattlesnakes are removed from newer rather than older neighborhoods.

**120 Breeding habitat selection of the western distinct population of the yellow-billed cuckoo (*Coccyzus americanus*) within Audubon Arizona Important Bird Areas**

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Poster

In the summer of 2015, Audubon Arizona staff and permittees surveyed five Audubon Important Bird Areas (IBAs) to determine cuckoo presence/absence and to assess breeding status. Using the protocol published by the USFWS, surveyors detected cuckoos 154 times, in four of the five IBAs. Of these sites, three supported birds that were likely breeding. One site contained habitat consistent with cuckoo natural history accounts – extensive cottonwood/willow riparian gallery forest with adjacent mesquite upland scrub and Madrean pinyon-juniper woodland. The second site was less consistent with cuckoo habitat descriptions with most detections occurring in extensive mesquite bosque along dry, ephemeral portions of the San Pedro River. The third site was the least consistent with previous cuckoo breeding habitat descriptions. Detections at this site were made in ephemeral drainages dominated by encinal oak woodlands and adjacent semi-desert grasslands. This use of what was thought to be atypical cuckoo habitat was also observed by Tucson Audubon biologists during their 2015 surveys of several oak-dominated drainages within southeastern Arizona sky island IBAs. Studies looking to determine presence/absence of cuckoos and eventual designation of critical habitat should consider these and potentially other habitat types.

**97 Natural resource applications of the phenology data and information housed in the National Phenology Database**

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Oral Presentation

The USA National Phenology Network (USA-NPN; www.usanpn.org) serves science and society by promoting a broad understanding of plant and animal phenology. An understanding of phenology, the timing of life-cycle events, sheds light on biological response to climate change, informs invasive species management, and plays a key role in engaging the public in nature and the scientific process. The National Phenology Database, maintained by the USA-NPN, is experiencing steady growth in the number of data records it houses. Since 2009, over 6,300 participants in *Nature's Notebook*, the national-scale, multi-taxa phenology observation program coordinated by the USA-NPN, have contributed over 6.5 million observation records of plant and animal phenology.

The phenology data curated by the USA-NPN are being used in a rapidly growing number of applications for science, conservation and resource management. Data and data products generated by the USA-NPN have been used in 17 peer-reviewed publications to date. Additionally, phenology data collected via *Nature's Notebook* is actively informing decisions ranging from efficiently scheduling street-sweeping activities to keep dropped leaves from entering inland lakes, to timing the spread of herbicide or other restoration activities to maximize their efficacy. We demonstrate several types of questions that can be addressed with this observing system and the resultant data, and highlight several ongoing local- to national-scale projects as well as some recently published studies. Additional data-mining and exploration by interested researchers and resource managers will undoubtedly continue to demonstrate the value of these data.

**121 Identifying Individual Skunks Using Pelage Patterns and Its Application to Rabies Management**

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Poster

Recognizing individual animals is critical for understanding many aspects of animal ecology and behavior, including estimating population size and the potential for disease spread, but individually marking animals can be costly in both time and money. Some species have enough variation in naturally-occurring markings that individuals can be recognized without adding artificial marks, tags or collars. We tested whether striped skunks in Flagstaff, Arizona could be reliably recognized based on naturally-occurring color patterns and whether camera trap position influenced how effective that technique was under field conditions. To answer the first question, we asked volunteers to estimate the number of skunks they could distinguish from an array of 28 photographs taken of striped skunks anesthetized and captured for other studies. To answer the second question, we placed 2 trail cameras at each of three winter den locations and photographed skunks either with the camera oriented vertically 30cm above ground so that photographs were taken from the side, or with cameras mounted 2 meters above the den entrance to capture photos from above. We then asked volunteers to estimate how many individuals they could recognize from a subset of 24 photos. We found that 1) volunteers reliably identified individual skunks based on coat color variation and 2) field identification was significantly better when cameras were mounted to capture photos from above. We demonstrated that natural variation can be used to recognize individual striped skunks if cameras are correctly positioned, and this should facilitate future studies of behavior, ecology, population dynamics and disease management. We then used this technique to determine the number of unique skunks utilizing a winter den in Flagstaff, Arizona. Contrary to behavior of skunks in more northern regions, striped skunks in Flagstaff remained active in the winter, and multiple individuals moved in and out of a winter den between October and January. This movement could be critical for maintaining diseases like rabies through winter via contact among individuals at these winter den sites.

**122 Bunny Business: jackrabbit population dynamics in the Sevilleta NWR**

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Poster

The black-tailed jackrabbit (Lepus californicus) is a keystone species in many desert ecosystems. On the Sevilleta National Wildlife Refuge in the Chihuahuan desert, jackrabbits are numerous and a primary food source for predators. Various agencies conduct long term ecological research (LTER) on the Sevilleta NWR in Socorro County, NM. Since 1992, the Bosque Ecosystem Monitoring Program (BEMP) and others have conducted quarterly nighttime surveys of the jackrabbit population in order to determine the density of rabbits and track their population over time. Surveys were conducted by driving a 21.5 mile loop near Black Butte while shining a high-powered spotlight out of each side of the vehicle. Rabbits were spotted by their eye-shine and

their position was determined using the vehicle's odometer and a rangefinder. Over the last 23 years there have been over 80 surveys and 3200 rabbit observations. During these surveys, both L. californicus and desert cottontail (Sylvilagus audobonii) were detected, though L. californicus was always observed in greater numbers than S. audobonii. We found a strong seasonal fluctuation of rabbits, with a minimum count of 8 rabbits in a winter survey, and a maximum count of 112 rabbits in a summer survey. We have also observed a relationship between precipitation and the number of rabbits. This is an ongoing study to help understand ecosystem dynamics of our desert environment on the Sevilleta NWR.

**94 Effects of non-motorized recreation on mid-size and large mammals in the San Francisco Bay area**

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Oral Presentation

Non-motorized recreation by humans and associated domestic animals can impact wildlife by disrupting normal maintenance routines, reducing feeding time, displacement from suitable habitat, increasing adrenal stress hormones, and provoking flight response. Past research suggests recreation negatively impacts abundance of carnivore species. I assessed species-levels behavioral changes of 10 mammals to human recreation both spatially and temporally. First, we investigated how different levels of hiking, biking, equestrians, and domestic dog presence impact habitat used by a suite of species. Next, we investigated diel shifts in activity patterns of wildlife in areas with no recreation compared to areas with any recreation and high levels of recreation.

To leverage public support, conservationists typically want to allow recreation in protected areas. Thus, limiting outdoor recreation may decrease public support for land and wildlife conservation. Our results indicate that species differ in their response to non-motorized recreation. A handful of species showed aversion to certain types of human recreation and exhibited spatial avoidance of sites with recreation while other species shifted their diel activity patterns to avoid contact with recreation; still others had no negative temporal or spatial response to recreation. Species may have adapted or already responded to the long history of recreation in protected areas in the Bay area. For the species included in analysis and that are impacted, none are identified as sensitive, threatened, or endangered. It is therefore our stance that the impacts are small in relation to the multiple gains such as human health benefits and continued political and financial support for land and species conservation.

**19 Restoring composition and structure in southwestern frequent-fire forests: a science-based framework for improving ecosystem resiliency**

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Oral Presentation

Ponderosa pine and dry mixed-conifer forests in the Southwest United States are experiencing, or have become increasingly susceptible to, large-scale severe wildfire, insect, and disease episodes resulting in altered plant and animal demographics, reduced productivity and biodiversity, and impaired ecosystem processes and functions. We present a management framework based on a synthesis of science on forest ecology and management, reference conditions, and lessons learned during implementations of our restoration framework. Our framework focuses on the restoration of key elements similar to the historical composition and structure of vegetation in these forests: (1) species composition; (2) groups of trees; (3) scattered individual trees; (4) grass-forb-shrub interspaces; (5) snags, logs, and woody debris; and (6) variation in the arrangements of these elements in space and time. Our framework informs management strategies that can improve the resiliency of frequent-fire forests and facilitate the resumption of characteristic ecosystem processes and functions by restoring the composition, structure, and spatial patterns of vegetation. We believe restoration of key compositional and structural elements on a per-site basis will restore resiliency of frequent-fire forests in the Southwest, and thereby position them to better adapt to future disturbances and climates.

## 71 Too dry for lizards: rainfall influence on lizard microhabitat use in an experimental rainfall manipulation within piñon-juniper

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Oral Presentation

Increasing temperatures have altered lizard behavior and microhabitat use and in many instances have led to population declines. As temperatures change, so to are precipitation patterns, but the effects of changing precipitation patterns on lizards remain poorly understood. Here we present an evaluation of lizard microhabitat use in a 5-year rainfall manipulation experiment in a piñon-juniper woodland. We examined ground temperatures and daily rainfall within four experimental treatments to address influences on the use of shade and sun microhabitats. Lizards showed a strong preference for shaded microhabitats during dry periods and used sunny microhabitats following rainfall events. These results highlight the importance of the shade provided by piñon-juniper trees to forage during dry periods. Our study shows that rainfall can influence lizard microhabitat use more than temperature in a piñon pine-juniper woodland and the trees provide important refugia. The loss of piñon pine and juniper trees from prolonged drought threatens to limit the amount of shade available to lizards in the future.

**40 Once upon a time in Mexico: prehistoric habitat suitability of the spotted bat**

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Oral Presentation

The geographic origin of the spotted bat (Euderma maculatum), a cryptic species patchily distributed from Mexico to Canada, is poorly known with only a single fossil record in Arizona. This mummified bat (10,500 years old) is the only indication that spotted bats lived north of Mexico in the early Holocene and no records suggest this species lived in the United States during the Wisconsinan Glaciation (80,000 to 11,000 years Before Present). To date, the spotted bat is thought to originate in Mexico but there is no environmental explanation of a northwestern immigration. Genetic analysis of 118 spotted bats revealed strong population structure (little to no gene flow) between central Mexico, the southwestern US, and the northwestern US and Canada. We used ecological niche modeling to predict prehistoric range distributions for the southwestern population using MAXENT modeling. The southwestern US population is genetically ancestral to the northwest and likely originated from southern Mexico. Predicted habitat was consistent with the known current distribution but did not extend into Canada, possibly indicating a difference in environmental preference between the southwest and northwest populations. Projection into 3 paleoclimates (last interglacial, last glacial maximum, and mid-Holocene) showed suitable habitat centered in Mexico to the lower edge of the southwest and a northward range expansion and recession 100,000 years later. While the Mexican-centered habitat is consistent with the fossil record and phylogeny, we anticipate further model validation to demonstrate waxing and waning of suitable habitat into the northwest.

**98 Using citizen science to monitor avian communities in the Arizona Sky Islands**

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Oral Presentation

The avifauna within southeastern Arizona Sky Islands includes species found nowhere else in the U.S. Thus, birdwatchers from across the globe visit the region, providing a vibrant state and local ecotourism industry. RMRS scientists initiated a bird study across montane forest and woodland types in 5 Coronado National Forest mountains from 1991 to 1995. Since then, the region has been under increased stress from ongoing drought and wildfires. We know little about fire effects on and habitat associations of Neotropical migratory birds in this region. Southern Arizona is also unique in having skilled citizens able to identify birds by sight and sound. These citizens are eager to assist with monitoring bird populations, but often are unfamiliar with design and implementation of rigorous monitoring programs. At the request of local citizens, RMRS scientists initiated a study in 2012 and 2013 in the Chiricahua Mountains to sample original and new trail transects in coordination with a local citizen group. For data calibration, a professional bird crew sampled trail and original transects in 2014. Our objectives were to 1) evaluate occupancy and detection differences between avian communities along trails versus original

transects, which cut across the terrain along a random direction, and 2) evaluate detection differences between professional bird crew and citizen scientist observers. We used multi-species, multi-season occupancy models to estimate species richness and local extinction/colonization, while accounting for imperfect detection. We show how this effort allows for inexpensive and statistically rigorous monitoring, and fosters greater local involvement in science and conservation..

**69 Effects of ambient light on puma, deer, and elk activity**

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Oral Presentation

Puma (*Puma concolor*) are nocturnal predators that depend primarily on concealment to capture prey. We asked whether puma activity and predation were affected by ambient light and particularly by lunar phase. We also asked if activity of mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) were similarly affected. To examine lunar effects on puma predation we compared the mean fraction of the moon illuminated between nights when kills were made and nights when kills were not made using a t-test. To examine activity patterns across illumination periods we conducted two sets of Chi-squared tests of independence. First, we compared photo counts across illumination periods of dawn, sunlight, dusk, dark, and moonlight for two study areas in New Mexico: the Bosque del Apache National Wildlife Refuge (BDA) and the Ladder Ranch (LR). The BDA is located in a riparian floodplain and has high human visitation. The LR is in canyon land foothills and human visitation is rare. Second, we repeated these analyses across periods of lunar illumination. Using data from 35 cameras operated for varying periods from 2008 to 2012, we recorded 791 puma photos, 2,922 mule deer photos, and 1,201 elk photos. Puma were primarily nocturnal; deer and elk were primarily diurnal. However, all three species were more active at night on the BDA and more active during daylight on the LR. Puma activity was not associated with lunar phase. Deer and elk were significantly more active in moonlight. Lunar illumination was not greater on nights when puma made kills.

**35 Cross-fostering: a novel tool for Mexican wolf recovery**

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Oral Presentation

All Mexican wolves (*Canis lupus baileyi*), both wild and captive, are descended from seven founders and three lineages; as such, this genetically distinct wolf subspecies has been afflicted by a genetic bottleneck since the onset of recovery. Reintroduced Mexican wolves have successfully bred and produced pups in the wild since 2000, and the wild population has grown to an estimated 110 individuals. However, minimizing inbreeding and maximizing retention of

genetic diversity remains a key goal for the long-term success of the population. Currently, 19 of 22 potentially breeding packs in 2016 have a descendent of a single pack as one of the members of the breeding pair; 84% of individuals with known genetics in the population are related to this pack. Introducing wolves from captivity with desirable genetic profiles into the wild population is necessary to combat potential inbreeding depression. Cross-fostering, a term for the rearing of non-maternal young by surrogate parents, is a method for introducing wolves with genetic profiles different from existing wild packs into the wild population. Cross-fostering involves the removal of captive or wild newborn pups from one den and subsequent placement into an active wild den of pups of similar age. Cross-fostering can provide an influx of genetics novel to the existing wild wolf population without potential hindrances of introducing naïve adult wolves. We successfully accomplished a cross-fostering event in 2014 and are planning more of these actions in the future to bolster recovery of Mexican wolves in the wild.

### 74 Microhabitat evaluation for northern Mexican gartersnakes at Bubbling Pond Hatchery

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Oral Presentation

The northern Mexican gartersnake (*Thamnophis eques megalops*) was listed as threatened under the Endangered Species Act in 2014. Bubbling Ponds Hatchery in Page Springs, Arizona, supports a robust population of this species, and natural resource managers are interested in using this site as a model for restoring and creating habitat to use for gartersnake conservation. The primary objective of this study is to determine microhabitat characteristics selected by northern Mexican gartersnakes at the hatchery. We deployed transmitters on 32 individual snakes, tracked movements weekly, and measured vegetative, cover, and abiotic variables in 1-m-diameter plots and along four associated 2.5-m transects. From May to mid-October 2015, we measured habitat at 207 unique snake locations, including 178 telemetry locations and 29 opportunistic observation sites. The same habitat measurements were taken at 207 paired random locations, allowing us to assess used versus available habitat. Preliminary findings support snake selection of areas close to water with a high amount of cover and vegetation. Snakes generally avoided areas with deep water. In mid-October, snakes began to move to hibernacula; data collected during this hibernation period will be analyzed separately. Tracking and habitat measurements will continue weekly through August 2016, enabling us to assess microhabitat selection during different seasons. The results of this study will be used to make recommendations to resource managers on parameters for habitat restoration and modification projects.

### 41 A Review of Echolocation Detection Studies

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Oral Presentation

Use of acoustic devices to detect echolocation calls is an important method for sampling bats. Technological improvements and analysis programs make it easier than ever to quickly collect large quantities of acoustic data and interpret it, often to species level. Our objective for this review was to compile, compare, and synthesize information from acoustic studies to better inform future projects. We conducted a literature search of peer-reviewed and gray literature. We assessed characteristics of each study such as its geographic location, type of detector used, season(s) of study, measure of bat activity, and microphone height. We identified 88 papers from 18 countries published from 1997 to 2015. Over half of the studies occurred in North America, 14% were conducted in Europe, and the remainder in Australia, Africa, and Asia. Most studies used a call rate (e.g., calls/hr) or presence/absence as a metric, but how bat activity was calculated varied among studies. Microphones were deployed from ground level to 108 m (mean ± SE: 10 ± 2 m). In temperate regions, 75% of the studies measured bat activity only during summer months. Half of the studies compared activity among treatment types (e.g., forest management); the remainder monitored bats. This review of acoustic studies gives an idea of the variability in acoustic studies. We suggest a common methodology to measure bat activity will assist comparisons among acoustic studies as this field continues to grow.

## 47 Using Non-invaisive sampling methods to reduce human-wildlife interactions on Camp Navajo, an Arizona Army National Guard Installation

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Oral Presentation

The main objective of this study was to understand black bear (*Ursus americanus*) and mountain lion (Puma concolor) spatial and temporal distributions in order to reduce the potential for human-wildlife conflicts while maximizing training opportunities on the installation. Camera traps and hair snares were utilized in an occupancy context to estimate species' distribution. We used a habitat classification model to create a sample framework using a hexagonal grid. Twenty cameras and 60 hair snares were placed randomly in selected grids and checked monthly for two years. Black bear occupancy was estimated at ~48 %( 0.48 ± 0.008 SE) by hair snare surveys and ~50 %( 0.50 ± 0.119) by camera trap surveys. Black bear detection probability was estimated with data collected from camera trap and hair snare surveys at ~11% (0.11 ± 0.013) and ~25 %( 0.25 ± 0.035), respectively. Mountain lion occupancy was estimated at 32% (0.32 ± 0.286 SE) from camera trap data. Detection probability for mountain lions developed from camera trap surveys was low (0.02 ± 0.016 SE). Results from both methods were consistent with year one of the study and identified high tree density as the primary driver for the black bear detection. The greatest likelihood for a human-bear encounter is in the southwest corner of Camp Navajo and along rugged terrain within the western buffer of the installation. Survey methods converged on similar results and proved to be an effective method for surveying for black bear detections but failed when surveying for mountain lion detections.

**21 Can incentives help overcome landowner concerns about conserving endangered species on their land? A rancher case study about jaguar critical habitat and rangeland conservation**

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Oral Presentation

Payments for ecosystem services (PES) programs may encourage private landowners to conserve threatened and endangered species on their land. Harboring threatened or endangered species may put landowners at risk of additional regulation or losing power to make decisions because of implications from the Endangered Species Act (ESA). However, private landowners are vitally important to endangered species conservation because of their large capacity to conserve and maintain habitat. Because landowners are apprehensive about the effects of the ESA on how they manage, PES programs that ask them to promote habitat for an endangered species likely have to be uniquely designed to address their concerns about additional regulatory burden. We used three methods to assess the interest of ranchers in southern Arizona and southwestern New Mexico in participating in PES programs for threatened and endangered species' conservation, and to determine what specific considerations need to be included in the design of such a program. Participants in our study were generally interested in hypothetical PES programs for threatened and endangered species' conservation. Results demonstrate that funding source for the program was important, programs must result in a net benefit to landowners, and regulatory assurances must be provided to landowners and their neighbors. These results are useful during preliminary stages of designing a PES program in the region of study, recognizing that further investigation into landowner preferences will be needed. Our approach is also a model for how other regions can evaluate stakeholder preferences before the initiating PES program design.

**16 Does a Bear Live in the Woods? A Study of Urban Black Bears in Northern New Mexico**

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Oral Presentation

Conflicts between humans and black bears, *Ursus americanus*, have increased in the recent decades, due to not only human encroachment on wildlife habitats but also anthropogenic attractions in urban areas (Beckman and Berger, 2003, a & b). Urban bears are a common sight

in the city of Raton in northeastern New Mexico, which has over 1,200 dumpsters, and almost all of them are not bear-proof. In some cases, urban systems act as demographic sinks, with bears becoming permanent urban residents. Some studies show them abandoning the behavior of hibernation, because of the year-long availability of food sources. (Beckman and Lackey 2008; Lyons, 2005). Understanding the dynamic between urban black bears and their use of urban systems is important to conservation and the management of human-wildlife conflicts, that are only going to increase in the future. The purpose of this study is to assess the nature of the bear urban behavior in comparison with rural populations. We found more fresh scat within city limits than outside city limits. Our results suggest that this specific population of black bears in Raton is not a permanent population. These results show that the bears are attracted to urban systems during summer months when food in the wild is scarce, and foraging on garbage is easier. When oak mast in the fall becomes available they prefer it over the anthropogenic food sources, and return to the wildlands. Human-caused bear mortality is correlated with annual precipitation and NPP which could be used as a tool by management agencies, especially in the face of drought to predict future bear mortality in the state of New Mexico.

## 102 Available data support protection of the Southwestern Willow Flycatcher under the Endangered Species Act

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Oral Presentation

Recently, Zink (2015) argued there was no evidence for genetic, morphological or ecological differentiation between the federally endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) and other Willow Flycatcher subspecies. Using the same data, we show there is a step-cline in both the frequency of a mtDNA haplotype and in plumage variation that is roughly concordant with the currently recognized boundary between *E. t. extimus* and *E. t adastus*, the subspecies with which it shares the longest common boundary. The geographic pattern of plumage variation was also concordant with previous song analyses that differentiated those two subspecies, even to the extent that both identified birds in one low-latitude, but high elevation, site in Arizona as the northern subspecies. We also demonstrate that the ecological niche modelling approach Zink (2015) used gave the same results whether it compared the two flycatcher subspecies, or *E. t. extimus* versus a different species (Yellow Warbler, *Setophaga petechia*). As a result, any interpretation of those results as evidence for lack of ecological niche differentiation among Willow Flycatcher subspecies would also indicate no differentiation among recognized species and would therefore be an inappropriate standard for comparing subspecies. We agree that many analytical techniques now available to examine genetic, morphological and ecological differentiation would better our understanding of the distinctness (or lack thereof) of Willow Flycatcher subspecies, but we argue current evidence does support protection of the Southwestern Willow Flycatcher under the Endangered Species Act.

**42 Does a gate's design or length of time installed affect bat use and behavior at abandoned mines in western U.S.?**

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Oral Presentation

Abandoned mines provide roosts for bats but also pose risks to humans (e.g., poisonous gases, instability). Gates installed at entrances of abandoned mines are meant to protect humans and bat habitat, but gates may negatively affect bat use. We used short- (days), mid- (months) and long-term (years) studies to evaluate how gate design affected bats in the western U.S. We examined use (e.g., activity level, type [maternity, night, day]) and behavior (e.g., circling, fly retreat) of bats as they encountered gates. Our short-term project used an in-situ mock gate experiment to document a 1-week behavioral response to culvert gates. Our mid-term project used internal and external surveys in a before-after-control-impact (BACI) study to monitor changes up to a year following gate installation. Our long-term study determined bat species richness (identified by DNA in guano) at abandoned mines 4 to 20 years after gates were installed. Our preliminary results indicate that bats have a strong negative short-term response to gates, causing them to increase energetically-demanding behaviors which may affect their fitness. We did not detect a difference in activity level in the BACI study, but noted a decrease of maternity use post gating. We successfully identified multiple species using abandoned mines after gates were installed ≥4 years. Our research will offer support for mine closure designs that minimize impacts on bat use of the sites, which will provide land managers with the tools for improving bat habitat availability.

**91 AgDiscovery Programs at Virginia State University and University of Hawaii at Manoa**

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Oral Presentation

APHIS and the host universities administer and operate the AgDiscovery programs across the nation. Agdiscovery offers students ranging from 14-17 years old an opportunity to experience the branches underneath the umbrella of agriculture. Each year the Office of Civil Rights, Diversity, and Inclusion hand selects students based on essays they submitted about their interests, hobbies, future career goals, and how they plan to achieve their goals. Each university receives a different amount of students ranging from 10-16 people. The camps are held at the university over a span of two weeks and are filled with activities from 7am-10pm. The campers shared a dorm with someone of the same sex and that shared liked interests. The activities were done with the entire group and counselors. The camps focused on their disciplines of either Animal or Plant sciences. The topics varied for each geographic location, Hawaii and Virginia.
There are many other camps across the U.S. that teach different disciplines. As alumnus of the camps, we will provide an overview of the camp activities and learning experiences from day to day as well as encouragement for future campers.

**123 Phylogenomic analysis of bobwhite quail in Southern Arizona and Mexico**

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Poster

The masked bobwhite (*Colinus virginianus ridgewayi*), native to southern Arizona and Sonora, is a species of quail on the verge of extinction. Masked bobwhite populations rapidly declined in the mid 1800's due to widespread habitat destruction. Despite extensive efforts, reintroduction attempts failed and the masked bobwhite was federally listed as endangered in 1967. In 1985, the Buenos Aires Ranch in Sasabe, Arizona was acquired by the USFWS as a national wildlife refuge for the masked bobwhite. A captive breeding program was established with birds being periodically released. However, surveys conducted for over a decade have shown an overall downward trend in populations in the United States and Mexico. Previous studies have analyzed genetic relationships among northern bobwhites; however, little is known regarding the relationships between masked bobwhite and its Mexican counterparts. The purpose of my research is to resolve taxonomic relationships among quail populations inhabiting geographic regions similar to that of the masked bobwhite. I will employ a high-throughput targeted genomic capture approach, which is very useful for reconstructing the evolutionary history of many organisms. I will use contemporary tissue and museum samples from nine bobwhite subspecies including Texas bobwhite (*C. v. texanus*), and seven Mexican sub-species. I will isolate and sequence approximately 5,000 conserved regions to construct phylogenetic trees to identify the closest extant relative of the masked bobwhite. The newly gained taxonomic information will aid the recovery efforts for the endangered masked bobwhite. This data will allow managers to make informed decisions regarding reintroduction of masked bobwhite.

**61 Relatedness of the Tamaulipas jackrabbit (Lepus altamirae): The case of Mexico's missing white-sided jackrabbit**

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Oral Presentation

Describing, naming and classifying organisms are essential for the fundamental understanding of biodiversity and its conservation. For decades, scientists have based the delineation of species predominantly on morphological characters. Over 1.7 million described species to date evidences the merit of this approach; however, in recent years, morphology-based species delineation has been complemented by DNA sequence data. The question of the missing jackrabbit arises from a pattern of biogeography which suggests that the white-sided jackrabbits were present in much of the Americas in the Pleistocene era, and since then, climate change and the arrival of the black-tailed jackrabbits have pushed white-sided jackrabbits to the eastern and western edges of their

former range. Surprisingly, an eastern analog to the white-sided *Lepus alleni* is missing in the literature. Historically, however, the morphological characteristics of the Tamaulipas Jackrabbit (*Lepus altamirae*), described as a distinctive species in 1909, showed its relationship with the white-sided group of jackrabbits and most alike to *L. callotis* and *L. flavigularis*. Decades later, the inclusion of *L. altamirae* in the white-sided group was questioned, and the species was placed in the black-tailed group of jackrabbits arguing its similarity to *L. californicus*. In this study, we amplified polymorphic regions of the mitochondrial cytochrome b gene of 2 museum specimens of *L. altamirae* collected in 1898 to determine its relatedness to 5 species of North American jackrabbits. Our goal was to determine if *L. altamirae* is the missing white-sided jackrabbit expected from the pattern of biogeography in the region, or if it is one of the black-tailed jackrabbits after all. We designed primers specific to jackrabbits for ancient and degraded DNA as is found in museum specimens. Preliminary results suggest that *L. altamirae* appears to be more closely related to the white-sided species of jackrabbits (*Lepus callotis*, *L. alleni*, *L. flavigularis*) than the black-tailed group (*L. californicus*). Modern DNA sequencing technology used alongside morphology and ecology is now essential to substantiate an organism's distinctiveness in the biological world ensuring its accurate classification for long-term sustainable management and conservation.

**37 Characterization of epigenetic variation in endangered Sonoran pronghorn, *Antilocapra americana sonoriensis***

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Oral Presentation

For several decades, wildlife managers utilized measures of genetic diversity as an indicator of a population's robustness to environmental perturbation. The applied field of conservation genetics has successfully adopted well-tested theory and, increasingly, powerful genome-probing technologies from the study of model species. Unfortunately, progress in linking genotypic variation to phenotypic variation in species of conservation concern has been limited due to the need for large sample sizes in systems lacking strict environmental control. Meanwhile, it is has become increasingly clear that epigenetic variation plays a large role in phenotypic variation and population response. It is therefore imperative that we explore the role of epigenetic variation in wild populations. This study surveyed epigenetic and genetic variation within and between subspecies of pronghorn, *Antilocapra americana*. Modeling the evolutionary potential of the endangered *A. a. sonoriensis* subspecies is of particular interest to managers given the threat posed to the subspecies by climate change. We conducted a survey of genetic and epigenetic variation between *A. a. sonoriensis* and the non-endangered *A. a. americana* subspecies. Additionally, we measured the annual stability of epigenetic variation within the recently re-introduced semi-captive population of *A. a. sonoriensis* and assessed if epigenetic differentiation exists within this population due to ancestry, age class, and sex.

**124 Spatial Ecology of Gray Foxes (*Urocyon cinereoargenteus*) in Southeastern Arizona**

VEALS, AMANDA M., John L. Koprowski, Kurt C. VerCauteren, and David L.Bergman.

Poster

Space use is a fundamental characteristic of a species' ecology that informs our knowledge about habitat selection, movement across landscapes, and both inter- and intraspecific interactions. The spatial ecology of gray foxes (*Urocyon cinereoargenteus*), is poorly known in the southwestern United States. Gray foxes are believed to be a large reservoir for rabies in the southwest; however, knowledge of gray fox movements across an expansive geographic area is lacking but can improve the success of any potential disease management plan. In order to make informed management decisions, knowledge of how foxes use the landscape is important to understand and control the spread of rabies in the case of a potential outbreak. We will compare the spatial ecology of foxes between a well-connected landscape, like the White Mountains, and an isolated sky island, such as the Pinaleño Mountains. We are particularly interested to understand habitat selection, movement patterns, and the home range requirements of gray foxes through the use of satellite collars. In addition, we will use a grid of remote wildlife camera traps to inform us on density, habitat use and co-occurrence with other carnivores. Through the application of occupancy modeling and resource selection functions, we will compare habitat use and resource selection between continuous and isolated forests. Our results on the spatial ecology of gray foxes in Arizona can be used to inform Arizona-specific disease control plans, but also can be applied more broadly across the southwestern United States.

**13 Next-generation sequencing vs. Microhistology: Investigating Diet Composition Variables of Mule Deer Populations on the Navajo Nation**

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Oral Presentation

Wildlife biologists have used diet composition variables as a means to extrapolate biological information to aid in the management and conservation of mule deer, Odocoileus hemionus. Much data are still unknown regarding the complexity of deer diet, including the plasticity of plant selection, especially among tribal wildlife agencies. Past studies have used non-invasive methods, such as microhistology via fecal analyses, to assess diet richness (i.e. the presence of unique plant items in a given diet) and taxonomic diet resolution (i.e. the identification of plant items to a given level of taxonomy in a diet) for mule deer. However, microhistology has several drawbacks including accuracy in identifying and differentiating plants at the taxonomic level of species, and even genus. Genetic techniques, such as next-generation sequencing (NGS), present new avenues for analyzing herbivorous wildlife diet, especially through the amplification and analyses of specific regions of chloroplast DNA (cpDNA). Additionally, few studies have compared microhistological and NGS diet analysis results for any species of animal. Our objectives were to compare both microhistological and genetic diet analysis results through diet richness and taxonomic diet resolution found in fecal matter of mule deer, with the hypothesis that the NGS technique would show greater diet richness and diet resolution than microhistology in the form of a greater number of unique plant items identified in each sample to the species and genus levels of taxonomy. Mule deer fecal samples were collected on the Navajo reservation

from two distinct populations of deer, among their respective summer and winter ranges. We found NGS results produced greater diet richness and taxonomic diet resolution to the species and genus levels of taxonomy among individual level diet analyses between both mule deer populations, within seasons. Genetic techniques may present innovative methods for determining mule deer diet in various ecosystems, and may also be applied to a broad range of herbivorous species diet studies.

**45 Upping the ante: bat species identification from gobs of guano**

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Oral Presentation

Wildlife genetic barcoding efforts can tap into sophisticated genomics approaches, where species ID can be determined from hundreds of samples simultaneously, for increased utility and decreased costs. Here, we adopt these approaches for an order of mammals (Chiroptera), using our previously validated Species from Feces DNA mini-barcode assay (nau.edu/batdna). Specifically, we 1) identified bat species that contributed to guano samples collected from across subterranean roosts; 2) identified bat species in guano fertilizer and other unexpected applications; 3) identified bat species from soil and water samples collected at roosts; and, 4) examined the limits of detection of our assay, meaning how rare a bat species' guano can be in a pooled sample and still be detected. We illustrate that the Species from Feces assay is conveniently transferable to low-cost, high-throughput next generation sequencing technology, and with high accuracy.

**23 Update on wildlife issues in review of renewable energy development projects and transmission lines and energy market based trends in project design and siting**

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Oral Presentation

The southwestern United States experienced a surge in proposals for renewable energy and transmission line projects for several years and the review or monitoring of these projects continues. Issues that may be identified by the wildlife biologist during evaluation of these projects will be outlined. Types of industrial scale solar and wind energy projects will be reviewed and trends discussed. Project associated impacts, including those from the footprint, construction, operation, and maintenance, will be reviewed, including issues such as injury and mortality of birds from solar flux and collision with structures in seemingly unlikely locations, and market impacts discussed. The review process for new power plants and the role and interaction of the various studies and documents will be discussed as well as opportunities for input by the wildlife biologist as a project progresses from baseline studies through the environmental review process to post construction monitoring and adaptive management.

**125 Change of high school students' attitudes toward snakes with and without live snakes in education programs**

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Poster

Snakes are often a widely feared taxa subject to stereotypes and irrational fears. My hypothesis regarding this confusion and fear around snakes comes from a lack of education and opportunities to handle snakes. I tested the effect that snakes have on high school students' attitudes about snakes while receiving information about the taxa. Students were assigned to one of two groups: one that received education with live snakes and one that received education without live snakes. Both groups took pre and post presentation attitude surveys. Education programs included natural history of local and regional snakes, how to safely handle snake encounters, and general education regarding the taxa. A similar study done with elementary school students, found that having an interactive experience with live snakes is the most beneficial to increasing students' positive feelings towards snakes. Preliminary results from this study show high school students have similar gains in positive attitudes when the animals are present during a lesson.

**126 Characterizing Marine Faunal Community Composition Across the Gulf of California Using Next-Generation Sequencing of Environmental DNA**

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Poster

Healthy oceans are vital to the survival of life on Earth. They moderate climate, are habitat to over 50% of the species on Earth, and yet less is known about the ocean and its inhabitants than any other ecosystem. Current biodiversity monitoring in the ocean relies on commercial fishing catch and limited small-scale observations through SCUBA or snorkeling surveys. Effective large-scale monitoring of marine communities is needed in order to understand the effects of human activities on the ocean as a whole and on regions of interest in terms of ecosystem function instead of just presence or absence of commercially fished species. The objectives of this study are to use environmental DNA (eDNA) to detect species presence in key marine communities in the Gulf of California with greater sensitivity than previous methods, and to develop eDNA analysis as a tool for monitoring relative abundance of key taxonomic groups in various community assemblages over a large geographic scale. Samples of water and marine sediment will be taken from several locations in the Gulf of California and DNA will be extracted in a dedicated laboratory for ancient and degraded DNA samples at the University of Arizona. DNA will then be processed two ways, first by PCR amplification of the barcoding regions, CO1, cytochrome b, and 16S and by developing new PCR primers specific to the Gulf of California taxa using the program ecoPrimers. The PCR products will then be sequenced on Illumina Mi-Seq. Secondly, a PCR-free approach will also be tested on a small subset of samples using eDNA extract, library preparation and then the Illumina Hi-Seq platform to test

the viability and cost of this method for potential use in the greater study. This project has the potential to improve marine monitoring methods in both scope and sensitivity, and to positively impact decision capability of policymakers in coastal regions.

### 127 A habitat suitability model for the Dusky Grouse in New Mexico

*** YOUTZ, JOSEPH A. (Undergraduate)[1,2], Reza Goljani[1,3], and Jennifer K. Frey[1,4].

Poster

The dusky grouse (*Dendragapus obscurus*) is a large game bird that occurs in boreal forests from southern Canada and Alaska south to isolated mountaintops in Arizona and New Mexico. This species has been ill-studied in the American Southwest where it is a protected game species. Our study aims to develop a habitat suitability map of dusky grouse in New Mexico using Maximum Entropy Modeling (MaxEnt). We collected occurrence records of dusky grouse from museum collections and the New Mexico Ornithological Society database. We assigned observations error based on the observer's knowledge. We constructed two models, one based on 6 biophysical variables, including elevation, GAP landcover, slope, aspect, distance to streams, and distance to springs, and one based on 19 standard bioclimatic variables. Elevation (87.4%) and landcover (10.7%) were the highest contributors to the biophysical model. The most important landcover types were subalpine grassland and bristlecone pine forest. The highest contributors to the bioclimatic model were annual precipitation (31.2%) and precipitation in the warmest month (23%). The largest and most suitable areas of grouse habitat were the northern mountains, while areas in the southern part of the state were small and fragmented. This could be an area of conservation concern considering the largescale fires that recently occurred in these areas. This species could be affected by recent land cover changes and the increasing effects of global warming. Future research will need to be undertaken in order to better understand this species and its current status in the American Southwest.

### 76 Demography of canyon treefrogs in desert mountain canyons

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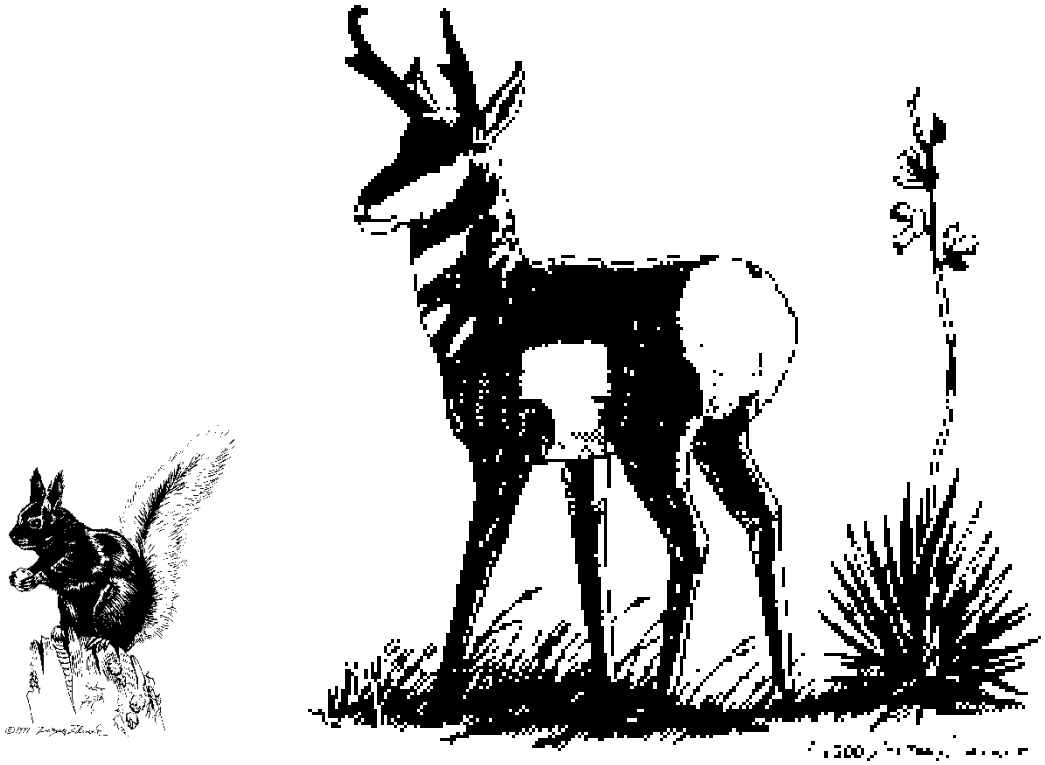
Oral Presentation

Understanding the biotic and abiotic factors that influence life history and demography is essential for effective conservation and management of wildlife, particularly for species that inhabit environments that are naturally varying and that are threatened by anthropogenic activities. Canyon treefrogs (*Hyla arenicolor*) inhabit mountain canyons in the desert southwest. These sensitive environments are subject to an array of threats, including climate change, which are expected to reduce the availability of surface water. Because we know so little about canyon treefrogs, our ability to predict population responses to these threats is limited. We used visual encounter (n = 56-74 surveys/site) and mark-recapture surveys (n = 10 surveys/site) to characterize demography of canyon treefrogs in the Rincon Mountains of southeastern Arizona. We marked 1830 adult and subadult frogs in 2014-2015, the majority of which were never recaptured (80%). For frogs that were recaptured, 81% were recaptured only once (mean recaptures/frog = 1.24, range = 1-6). Apparent monthly survival varied seasonally and was highest during winter (>0.90) and lowest during summer monsoons (<0.50). Annual survival averaged <3%, indicating that treefrogs rarely live ≥1 year after reaching the subadult age class. Low rates of adult survival suggest that treefrogs rely on high reproductive rates to persist in these environments, a pattern corroborated during visual encounter surveys as treefrogs reproduced in most canyon reaches during both spring and summer. Future hydrologic changes that reduce the availability of surface water during these seasons, however, could reduce reproductive rates and increase the risk of local extinction.



## Listed Alphabetically by Senior Author

**11 CFT Legumine™ (5% rotenone) Effects on Tadpole Survival and Metamorphosis of Chiricahua Leopard Frog (*Lithobates chiricahuensis*), Northern Leopard Frog (*L. pipiens*), and American Bullfrog (*L. catesbeianus*)**

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Oral Presentation

Conservation through restoration of imperiled fishes can result in indirect benefits to amphibian populations through removal of invasive predatory fishes. However, very limited information is available concerning the collateral effects of piscicidal applications to non-target amphibians. Of interest is the federally-listed Chiricahua leopard frog *Lithobates chiricahuensis*, a state-imperiled northern leopard frog *L. pipiens*, and the pervasive American bullfrog *L. catesbeianus*. In a series of 48 h static non-renewal tests, all three species in the earliest tadpole or Gosner stages (21-25) and mid-Gosner stages (31-36) were subjected to two concentrations of CFT Legumine (5% rotenone) (0.5 and 1.0 mg/L) to assess effects on delayed mortality and time to metamorphosis. Delayed mortality occurred in all three species exposed to CFT Legumine when compared to controls. Survivors did not experience reduction in mass, nor did survivors take longer to complete metamorphosis when compared to controls in all three species. However, tadpoles of the Chiricahua leopard frog that survived 1.0 mg/L required 205 hours to resorb their tails when compared to 102 hours in the controls. Tadpoles of the northern leopard frog exposed to 1.0 mg/L resorbed their tails in 161 h in contrast to controls, which resorbed their tails in 78 h. When exposed to 1.0 mg/L, the American bullfrog resorbed their tails within 125 h, while controls resorbed their tails within 69 h. Earliest tadpole stages of the three *Lithobates* spp. were more susceptible to environmentally relevant concentrations of CFT Legumine™ (1.0 mg/L) with survivors experiencing a delay in time to tail resorption, which may increase their vulnerability to predation and pathogens.

**6 Refuge populations of White Sands Pupfish diverge in the absence of high gene flow**

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Oral Presentation

White Sands Pupfish (Cyprinodon tularosa) is endemic to the Tularosa Basin in south-central New Mexico and is listed as threatened by the state of New Mexico. Two extant evolutionarily significant units (ESUs) occur in Salt Creek and Malpais Spring. Recovery efforts have included establishing and maintaining natural refuge populations for the Salt Creek ESU. We characterized genetic diversity in 313 C. tularosa individuals from the naturally occurring ESUs (Malpais Spring, Upper Salt Creek, and Lower Salt Creek) and the two refuge populations (Lost River and Mound Spring) using 24 microsatellite loci. We found five genetically distinct groups of C. tularosa: Malpais Spring, Upper Salt Creek, Lower Salt Creek, Lost River, and Mound Spring. While the Mound Spring and Lost River populations were founded by individuals from Lower Salt Creek, these refuge populations have diverged from Lower Salt Creek through genetic drift. Using historic 1983 samples from Lower Salt Creek, we determined that levels of genetic diversity have remained stable over the last 30 years with the genetic diversity from the Lower Salt Creek population being preserved among the Lower Salt Creek, Mound Spring, and Lost River populations combined. Therefore current conservation efforts have achieved the goal of preserving the Lower Salt Creek population, with the exception of the genetic drift observed in Lost River and Mound Spring. Increased translocations among Lower Salt Creek and its refuge populations would reduce further genetic drift and result in refuge populations that are more representative of the original Lower Salt Creek population.

## 80 Ground-Based Thermal Imaging of Stream Surface Temperatures: Technique and Evaluation

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Oral Presentation

We evaluated a ground-based hand-held thermal imaging system for measuring water temperatures using data from eight southwestern USA streams and rivers. We found hand-held thermal imagers could provide considerably more spatial information on water temperature (for our unit one image = 19,600 individual temperature measurements) than traditional methods could supply without a prohibitive amount of effort. Furthermore, they could provide measurements of stream surface temperature almost instantaneously compared to most traditional means such as hand-held thermometers (> 20 seconds per reading). Spatial temperature analysis is important for measurement of subtle temperature differences across waterways, and identification of warm and cold groundwater inputs. Hand-held thermal imaging is less expensive and equipment intensive than airborne thermal imaging methods, and is useful under riparian canopies. Disadvantages of hand-held thermal imagers include their current higher expense compared to thermometers, their susceptibility to interference when used incorrectly, and their slightly lower accuracy than traditional temperature measurement methods. Thermal imagers can only measure surface temperature, but this usually corresponds to subsurface temperatures in well-mixed streams and rivers. Using thermal imaging in select applications, such as where spatial investigations of water temperature are needed, or in conjunction with stationary temperature data loggers or hand-held electronic or liquid-in-glass thermometers to characterize stream temperatures by both time and space, could provide

valuable information on stream temperature dynamics. These tools will become increasingly important to fisheries biologists as costs continue to decline

**25 Use of ultrasonic imaging to evaluate egg maturation of humpback chub *Gila cypha* in the Grand Canyon**

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Oral Presentation

Humpback chub *Gila cypha* are endangered cyprinids endemic to the Colorado River drainage and are adapted to live in fast currents of warm, turbid water. Although nine known aggregations of humpback chub currently exist in the main-stem Colorado River in the Grand Canyon, little is known about their reproduction. We hypothesized that Colorado River water temperatures below Glen Canyon Dam are too low due to hypolimnetic dam releases for female humpback chub to develop mature eggs for spawning. Ultrasonic imaging is a non-lethal method that has been used to determine sex and maturity of a variety of freshwater, anadromous, and marine fishes. However, these studies typically use captive fish in a laboratory and not wild fish in the field. Our goals were to develop ultrasonic imaging, a non-lethal method, to identify gamete development and to evaluate gamete maturity in female humpback chub in the Grand Canyon. We developed a standardized protocol for ultrasonically scanning humpback

**12 Asian Tapeworm in an Endangered Southwestern Fish: Assessing Infections Using a Non-lethal Molecular Screening Tool**

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Oral Presentation

The current standard for positive identification of fish Asian tapeworm *Bothriocephalus acheilognathi* infection is necropsy and visual examination of the gut via microscopy. While this methodology is considered the "gold" standard for positive identification of this parasite, a lethal detection method is not ideal for assessing parasitic infection in endangered fish. The goal of this research is to determine whether swabbing for genetic material from the anogenital vent could replace terminal sampling of fish to confirm *B. acheilognathi* infection. We conducted an

experiment in which n=575 captive humpback chub Gila cypha previously exposed to *B. acheilognathi* were swabbed and necropsied to assess presence/absence of infection. DNA was extracted from the swabs and polymerase chain reaction was used to amplify portions of the *B. acheilognathi* 18S rRNA gene ITS2 region. Gel electrophoresis and sequence analysis was conducted to quantify the sensitivity and specificity of the molecular methodology. Mean primer set sensitivity was 48% while mean specificity was 76%. Results indicate that these primers are neither sensitive nor specific enough for detection of *B. acheilognathi* in mixed-template from fecal swabs. Alternative primer development is underway to target the *B. acheilognathi* COXI mtDNA subunit. The new primer will be utilized on swabs collected in a field study to screen wild populations of humpback chub for *B. acheilognathi* and assess prevalence. Successful development of a non-lethal molecular diagnostic tool will provide managers with a viable alternative to the current terminal standard for assessing infection and quantifying prevalence in endangered hatchery and wild fish populations.

**5 Pecos Pupfish conservation and mangement in New Mexico**

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Oral Presentation

Pecos Pupfish are listed in New Mexico as threatened primarily because of habitat loss and potential for hybridization. Pecos Pupfish annual monitoring began in 2011 to determine if conservation objectives for the species are being met. Representative sites in Bitter Lake National Wildlife Refuge, Bottomless Lakes State Park, and the BLM Overflow Wetlands are sampled with minnow traps during spring. Year to year catch rates have been variable with sinkhole habitats having the highest catch rates and shallow wetland habitats having the lowest catch rates. Two sinkhole sites have shown declining catch rates over the five year monitoring period. However, the decline in catch rates may be due to variable water levels among monitoring years. Possible conservation actions include improving the BLM Overflow Wetlands barrier.

**27 The contribution of the Gila River Native Fishes Recovery Program (GRBNFCP/CAP) to the recovery of native aquatic species**

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Oral Presentation

The Central Arizona Project, in 1994, was found to jeopardize the Gila topminnow, spikedace, loach minnow, and razorback sucker under Section 7 of the Endangered Species Act. As part of the reasonable and prudent alternative to remove jeopardy, the Bureau of Reclamation funded two programs: the recovery of native species, and management against non-native species. The program intended to recover the four jeopardy species in-lieu of threat removal. Funding of the programs began in 1997, have continued since, and have greatly contributed to recovery of the four jeopardy species, and to other Gila River Basin native aquatic species.

In addition to the four jeopardy species, the Gila chub and Chiricahua leopard frog, and other native listed, candidate, and unlisted fishes of the Gila River Basin have benefited from the GRBNFCP. Numerous tasks identified in species recovery plans have been implemented, or

partially implemented, under tasks funded through the GRBNFCP. We will enumerate how many tasks in recovery plans have been implemented, or partially implemented, under the GRBNFCP. We will also discuss how the GRBNFCP has enhanced the conservation status of native Gila River basin native aquatic species

### 79 The Resilience of Sea Turtles to Climate Change through a Quantitative Framework

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Oral Presentation

Marine turtle life history, like most aquatic vertebrates, is intrinsically linked to climatic variables and thus they may be good indicator species for the impact of climate change. Despite an increasing amount of research, the data to quantify climate change impacts remains patchy and in particular how resilient marine turtles may be to climatic change. We reviewed key literature for three marine turtle species (Olive Ridley, hawksbill and leatherback turtles) to determine a quantitative resilience score for each regional management unit (RMU) population. Our results reveal that the most resilient of these three species is the leatherback population in Western Pacific and the least resilient is the leatherback population in the Eastern Pacific. Populations that had high resilience scores but low certainty due to limited spatial coverage of the data included the Olive Ridley population in West Pacific and the hawksbill population in the Southwest Indian. The review also highlighted that data describing primary sex-ratios, diet and non-human predation were limited. Furthermore, the framework presented here was developed to be the basis for future quantitative-resilience studies on other taxon, both marine and terrestrial.

### 9 Reproductive Potential of Wild Rio Grande Silvery Minnow (*Hybognathus amarus*)

*** FALCO, HUNTER[1,3], Colleen A. Caldwell[1,4], William Knight[2,5], and Manuel Ulibarri[2,6]. [1]New Mexico State University, Department of Fish, Wildlife and Conservation Ecology, 2980 S Espina Street, Knox Hall, Room 132, Las Cruces, Mexico 88003, [2]U.S. Fish and Wildlife Service, Southwestern Native Aquatic Resources and Recovery Center, 7116 Hatchery Road, Dexter, New Mexico 88230,[3]hrfalco@nmsu.edu. [4]ccaldwel@nmsu.edu. [5]William_Knight@fws.gov. [6]Manuel_Ulibarri@fws.gov.

Oral Presentation

The Rio Grande silvery minnow (RGSM; *Hybognathus amarus*) was listed as federally endangered in 1994 and currently inhabits less than 7% of its historic range (from the Rio Chama and Pecos River in northern New Mexico to the Gulf of Mexico). Captive propagation and augmentation have occurred since 2001. The majority of wild-caught adults are age 1+ with a smaller portion represented by 2+. However, captively propagated stocks have maintained year classes up to 4+ years of age. Information is needed to determine the fecundity of the various age classes of hatchery-reared RGSM to better manage captive stocks for augmentation into the wild. Our objectives were to determine fecundity of captively-reared 1, 2, 3 and 4 year old adult RGSM, compare actual egg counts to volumetric estimates, calculate egg diameter for age classes, and assess the percent fertilization of eggs in each age class. Spawning trials were

conducted on four age classes (year hatched/age class): 2009/4, 2010/3, 2011/2, 2012/1. Photo images were used to enumerate eggs from ten female fish (n=10) from each age class. As expected, actual counts increased as fish age increased. Fecundity increased with age of females from 2,362 eggs (standard error + 302.4) in age-1fish to 10,495 eggs (+ 784.1) in age-4 fish. Estimated and actual counts differed from one another. As total eggs increased in the older age classes, the percent difference increased between 6.6 and 15.7%. Fertilization rate appeared to increase with age.

### 77 Effect of Enrichment in the Hatchery on the Performance of Brook Trout and Atlantic Salmon

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Oral Presentation

Fish culture environments may play an important role in the survival of stocked hatchery fish. Fish raised in plain hatchery environments have little exposure to complex environments that more closely resemble stocked streams and lakes. By creating environmental complexity and variability during a fish's residence in a hatchery environment, fish may have the ability to learn and alter behavior in ways that increase post-stocking survival. We have investigated the addition of variability in the environment of hatchery-reared Brook Trout (*Salvelinus fontinalis*), and Atlantic Salmon (*Salmo salar*), by assessing behavioral changes and post-stocking survival in several Adirondack lakes. Our findings have shown a change in adaptive behavior prior to stocking, as well as a survival advantage in a controlled laboratory setting. It did not result, however, in increased survival rates when the Brook Trout and Atlantic Salmon were stocked into Adirondack lakes.

### 55 Evaluating effectiveness of side-scan sonar in assessing littoral habitat diversity in reservoirs

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Oral Presentation

Fish habitat is a crucial component in our lake and reservoir systems and there are a limited number of cost effective tools available to evaluate current conditions. The objective of the study was to determine if low-cost side scan sonar is an effective tool at classifying shoreline substrate. Shoreline sonar surveys were conducted in October 2014 using low-cost side scan sonar (Humminbird ONIX 10SICI unit). Substrate was classified into five substrate classes; sand (S), rocky fine (Rf), rocky boulder (Rb), vegetation (V), and cliff face (CF). Snorkel surveys conducted in August 2015 were used to evaluate the sonar substrate classification system by creating a referenced data set. Thematic accuracy of the Roosevelt Lake shoreline substrate map was evaluated using a standard error matrix. The standard error matrix resulted in an overall accuracy of 75% while normalized accuracy was 76% using Margfit analysis. The results of our

study confirmed low-cost side scan sonar as an effective tool to evaluate shoreline substrate in reservoir systems. We did encounter two main limitations; one in differentiating between substrate types and the second in a loss of data due to shadow effect in the sonar images. Despite the limitations, side scan sonar offers the ability to evaluate reservoirs that was previously too costly and time consuming. Substrate classification can be used to improve proficiencies at identifying fish habitat limitations and identifying optimal locations to conduct fish habitat improvement.

## 57 The Fate of Stocked Trout in Arizona Streams

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Oral Presentation

A multiyear study was initiated in 2013 to evaluate aspects of Arizona's stocked trout program. Specifically, approaches including depletion surveys, stocking manipulations, creel surveys, and radio telemetry were employed on six Arizona streams to better understand the fate of stocked trout after stocking, cost effective stocking densities, and angler success and satisfaction. We found that angler satisfaction was highly correlated with catch rates, which were variable by stream, the number of trout stocked, and the length of time since the last stocking. Thus, adjusting stocking densities and the day of stocking can be methods for improving overall angler satisfaction.

Radio telemetry records revealed substantial proportions of predation on stocked trout. Equal proportions of radio tagged fish were killed by predators (~24%) as were harvested and reported by anglers (~23%). In general, fish movement from stocking locations was minimal (<50m), however, downstream movements over one kilometer were observed. Larger distances of movement were observed in Rainbow trout when compared to Apache Trout. Median longevity post stocking was three days and six days for the Little Colorado River and the East Fork Black River, respectively; however, some individuals remained in the stream over three months post stocking. Our results address previous unknowns and allow managers to make informed decisions on stocking practices and densities in the future.

## 56 Two case findings: Possible Loma salmonae in yearling apache trout at Silver Creek hatchery and the identification of a highly pathogenic form of Saprolegnia infecting and killing rainbow trout and apache trout at Tonto Creek hatchery

MARCINO, JOE, Fish Pathologist, Arizona Game and Fish Department, Phoenix.

Oral Presentation

During routine examinations of rainbow trout gill tissue at Silver Creek fish hatchery, multiple areas of the primary and secondary lamellae exhibited cysts filled with what appeared to be microsporideans similar to Loma salmonae. Formalin fixed tissues were screened for Loma salmonae by endpoint PCR using the primer set described by Docker (DAO, 1997). A band of the appropriate size was observed on a 1.5% agarose gel suggesting a positive identification of Loma salmonae. DNA sequencing of the PCR product is currently underway.

Escalated mortalities of rainbow and apache trout fry at the Tonto Creek fish hatchery in early 2015, demonstrated clinical signs similar to those caused by Bacterial Coldwater disease (*Flavobacterium psychrophilum*). Upon histological examination an invasive Saprolegnia sp was observed with no *Flavobacterium psychrophilum* present. Histological findings and PCR results will be discussed.

**30 Improving ESA Implementation: The Species Status Assessment framework**

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Oral Presentation

The U.S. Fish and Wildlife Service developed the Species Status Assessment (SSA) framework as part of the ongoing effort to improve implementation of the Endangered Species Act (ESA) and enhance conservation success. An SSA is a focused, repeatable, and rigorous assessment of a species' ability to maintain self-sustaining populations over time. This assessment is based on the best available scientific and commercial information regarding life history, biology, and consideration of current and future vulnerabilities. The result is a single document that delivers foundational science for informing all ESA decisions, including listing determinations, consultations, grant allocations, permitting, and recovery planning

**28 Repatriation of Gila Chub into Mule Creek, New Mexico**

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Oral Presentation

Reestablishing Gila Chub *Gila intermedia* into unoccupied waters in their former range is an important recovery step identified in the Gila Chub Draft Recovery Plan. Gila Chub is a federal and state listed species that the New Mexico Department of Game and Fish, in cooperation with the Arizona Game and Fish Department, U.S. Fish and Wildlife Service and U.S. Forest Service, is working to recover in New Mexico. The process starts by evaluating potential repatriation waters and source populations. Mule Creek in New Mexico was chosen as an appropriate site to replicate the Harden Cienega population. Gila Chub have been collected from Harden Cienega and stocked into Mule Creek for three consecutive years. To date, a total of 299 Gila Chub were stocked using different methods each year. The geographic isolation of the stocking site provides protection for the population, but makes access difficult. The preferred method for transferring fish to the stocking location is via helicopter long line, but it is weather dependent, which led to no fish being transferred in 2015. Surveys show Gila Chub persisting in Mule Creek despite high flow events. Additional stockings to ensure robust genetics are planned as well as ongoing population monitoring. This project has provided many learning opportunities for Threatened and Endangered fish management.

**31 Spikedace and loach minnow mesohabitat use in repatriated streams in Arizona**

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Oral Presentation
Several papers have been published on habitat preferences of spikedace and loach minnow in wild streams; however, the establishment of these two species continues to be problematic at sites considered suitable habitat. Our objectives were to evaluate associations between mesohabitat type and abundance of each species in several repatriated streams in Arizona. Fish assemblages were sampled annually between 2011 and 2015 using backpack electrofishing. We found that spikedace and loach minnow (and other co-existing native fish) selected for specific mesohabitat types; however, that these associations varied across repatriation streams. Overall, loach minnow were associated with riffle habitat, whereas spikedace were associated with runs in the Blue River and riffles and runs in Hot Springs Canyon. Several factors could influence habitat utilization by fish in streams including, stream discharge, habitat availability, presence of nonnative species, and fish abundance. Therefore, repatriation sites should be evaluated on an independent basis to determine if stream hydrology and fish interactions may limit spikedace and loach minnow reintroduction success.

**58 Weight counts in aquaculture: Debunking some myths**

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Enumerating fish is critical to the operation and efficiency of an aquaculture production program. The most common way of counting fish is by determining fish/lb (weight count) and weighing them any time they are moved. There exists a wide variety in the methods used to determine weight counts, and little agreement on the most accurate way. Some put considerable effort into making a sample as representative as possible, some feel that less effort is warranted with time gained. I set out to determine if there was any difference in common methods used to determine weight counts. Numerous trials were conducted for each method in a population where the true weight count was known. Small and large samples were compared, along with the number of samples needed to achieve accuracy. It was found that none of the methods used departed from the true weight count. Small and large samples did not differ in accuracy, but did differ in variances. The number of samples required to achieve accuracy depends on the individual performing the weight count and the size of fish. The results follow probability theory very well, and efforts should be made to satisfy probability theory assumptions

**3 Flannelmouth Sucker distribution, movement and growth within the Colorado River, Arizona**

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Oral Presentation
The Flannelmouth Sucker is one of four remaining native fish species found within the Colorado River between Glen Canyon Dam, Arizona and Lake Mead, Nevada. Flannelmouth Sucker historically underwent large migrations, but since impoundment of the Colorado River they have been restricted to a closed-off regulated river system. Alteration of historical Colorado River conditions has adversely impacted the native fish fauna. We investigated distribution, movement, growth, survival and population size of Flannelmouth Sucker from PIT (Passive Integrated

Transponder) tag mark and recapture events (1991-2015) from long-term monitoring studies conducted by Arizona Game and Fish Department, U.S. Fish and Wildlife Service, and Grand Canyon Monitoring and Research Center. Flannelmouth Sucker are present throughout the Colorado River between Glen Canyon Dam and Lake Mead (~460 km) but tend to be more abundant in the lower reaches below the Little Colorado River (LCR; ~120 km below Glen Canyon Dam). From a random subset of total marked Flannelmouth Suckers, 40% were recaptured at least once within the LCR. Movement, growth, and survival of Flannelmouth Suckers varied with size. Adult fish (≥ 282 mm) moved relatively little (36.0 km/yr.), while subadult fish (150-281 mm) moved greater distances (65.7 km/yr.). Adults grew an average of 34.6 mm per year, while subadults grew an average of 81.9 mm per year. Apparent yearly survival for adult and subadult Flannelmouth Suckers was 68.9% and 57.8% respectively. These results will help define conservation and management objectives as regulated river systems become more common worldwide.

### 78 Mechanical removal of Green Sunfish (*Lepomis cyanellus*) in East Ash Creek, Bill Williams Drainage

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Oral Presentation

East Ash Creek has populations of Speckled Dace (*Rhinichthys osculus*), Lowland Leopard Frogs (*Rana yavapaiensis*), and Black-necked Gartersnakes (*Thamnophis eques*). While no crayfish or Black Bullhead Catfish (*Ameiurus melas*) are present, Green Sunfish (*Lepomis cyanellus*) are present and pose a threat to the native species. The sunfish had invaded 2.4 km (1.5 miles) of East Ash Creek while dace were found only in the lower 1.6 km (1.0 miles) of the perennial reach in identified pools 1-20. In general, dace and frogs are in lower densities when Green Sunfish are present and higher densities when Green Sunfish are absent. This project has been implementing the removal of Green Sunfish from East Ash Creek since November 2013 to benefit Speckled Dace and Lowland Leopard Frog populations. In 2013, forty-five pools were initially identified with Green Sunfish within a 2.4 km (1.5 miles) reach. Beginning in November 2013, the Arizona Game and Fish Department (AGFD) Region III Fisheries Program led an effort to mechanically remove Green Sunfish in 2.4 km (1.5 miles) of East Ash Creek. Green Sunfish were removed monthly via hook-and-line, backpack electrofishing, minnow traps, hoop nets, and spotlight-electrofishing. To date, 1,791 Green Sunfish have been removed and have not been observed in the creek since October 2014

### 8 Relationship between AFS standard fish sampling techniques and environmental DNA (eDNA) for characterizing fish relative abundance, biomas, and species composition in Arizona standing waters

***PEREZ, CHRISTINA R. [1,6], Scott A. Bonar[1,7], Jon J. Amberg[2,8], Chris Rees[2,9], Bridget Ladell[2,10], Taylor Edwards[3,11], William T. Stewart[4,12], Curtis Gill[5,13], and Chris Cantrell[4,14]. [1]U.S. Geological Survey Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, School of Natural Resources and the Environment, 1311 E. 4th Street, Biological Sciences East 325, Tucson, Arizona 85719, [2]U.S. Geological Survey Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Rd., La Crosse,

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Oral Presentation

Examination of deoxyribiose nucleic acids in water samples (environmental DNA or eDNA) has shown promise for identifying fish species present in waterbodies. In water, eDNA is the result of bodily secretions such as mucus, gametes, and feces. We are investigating whether eDNA can be effective for characterizing fish relative abundance, biomass, and species composition in large (>200 ha) and small (<200 ha) waterbodies. Study sites included a large waterbody (Theodore Roosevelt Lake) and 12 small (< 200 ha) waterbodies located in Arizona. Our primary objective was to compare fish relative abundance, biomass, and species composition measured through eDNA methods and established American Fisheries Society (AFS) standard sampling methods. In Lake Roosevelt we compared Largemouth Bass Micropterus salmoides and Gizzard Shad Dorosoma cepedianum catch at electrofishing and gillnetting sites with their eDNA in water samples collected at those same sites. We found no relationship between relative abundance and biomass of these fish captured by established methods and their DNA copies at individual sites or by lake section in Lake Roosevelt. However, eDNA reflected relative proportions of Largemouth Bass and Gizzard Shad in total catch composition for the reservoir. Our large reservoir study suggests eDNA collections will not be useful for in-lake comparisons in a large, mixed reservoir such as Lake Roosevelt. However, they may be useful for characterizing relative abundance and biomass in an overall lake. Analysis is currently underway for the 12 small waterbodies. Further evaluation of environmental DNA is necessary to identify limitations and benefits in fish monitoring programs.

## 10 Effects of Tagging with Passive Integrated Transponders versus Visual Elastomer Implants on the Small-bodied White Sands Pupfish (*Cyprinodon tularosa*)

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Oral Presentation

Despite the assumption that body size is the most common primary predictor of individual tagging effects in fish, few studies have focused on tagging effects of small bodied fishes. To test our hypothesis that body size predicts the probability of survival among tagged small-bodied fish, we compared 8.5-mm passive integrated transponder (PIT) with visual implant elastomer (VIE) to assess tagging related mortality, tag retention, and growth (total length, TL and mass, g) among four size classes of White Sands pupfish (*Cyprinodon tularosa*): 15-29 mm and 0.1-0.6 g; 30-39 mm and 0.4-1.2 g; 40-49 mm and 1.0-2.2 g; 50-59 mm and 2.3-4.2 g throughout 75 d observation period. Fish mass was a good predicator of the probability of survival across all

PIT-tagged pupfish (P=0.016) where pupfish were 62 times more likely to survive tagging as mass increased by 1.0 gram. Nor surprising, the smallest size class (15-29 mm TL) experienced the greatest mortality (72%). VIE related mortality was marginally different from the controls (P=0.076) compared to those with a PIT tag indicating slightly better survival in pupfish with PIT tags. The growth rate of all tagged animals was similar to controls. Our data indicated that White Sands pupfish can be effectively tagged using 8.5-mm PIT tags with minimal tag loss or mortality at sizes ≥37 mm and that survival was marginally better than in VIE-tagged pupfish. This research has provided specific information needed to describe demography using mark recapture and occupancy modeling in this small-bodied southwestern fish.

**26 Wildfire effects on genetic diversity and recolonization of longfin dace, *Agosia chrysogaster***

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Oral Presentation

Wildfires are important disturbance events for cold and warm-water stream biota of southwestern North America. Whereas wildfire effects on abundance and community composition are relatively well-documented, effects on genetic diversity and structure are not. From 2011 to 2013, the upper Gila River basin experienced a series of wildfires with associated ash flows that led to local extirpations of fishes. One species, longfin dace (*Agosia chrysogaster*), is an abundant and widespread native that exhibits a "boom-bust" ecology and a rapid colonizer, making it an ideal candidate for evaluating wildfire effects on fishes. We used genetic data collected pre-wildfire (2010), immediately following the Whitewater-Baldy Fire (2012), and 2 years post Whitewater-Baldy (2014) to evaluate changes in genetic diversity and genetic structure that resulted from extirpation and recolonization of habitats. Despite declined abundance, estimates of genetic diversity and genetic effective size did not change appreciably following the wildfires. Changes in genetic structure over time were consistent with expectations of recolonization by dispersal of populations from Cliff-Gila Valley and upstream refuge habitats. Longfin dace appeared to exhibit genetic resilience to the wildfires that is facilitated by the unmodified nature of the upper Gila River. Understanding recolonization processes of longfin dace will inform on the same processes occurring for co-distributed endangered spikedace and loach minnow.

**7 Retrospective food web analysis of the Gila River: Do native and non-native interactions intensify during drought?**

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Oral Presentation

The relatively pristine Upper Gila River in New Mexico is a stronghold for endemic native fishes despite the presence of nonnative fishes. In other, more severely human-impacted tributaries in the Colorado River basin, nonnative fishes are a major factor in native species extirpation. We tested whether negative effects of nonnatives on natives are compounded during challenging hydrologic conditions (i.e., drought). Stable isotope analysis (SIA) allows estimation of trophic position, and trophic niche width. Fish specimens were selected from natural history collections to represent a time series that encompasses wet and dry years, as well as varying non-native abundances. We estimated 'isotopic niche space' by plotting δ13C vs. δ15N for native and nonnative fishes and statistically compared breadth and overlap in niches among species. During drought periods, isotopic niches of nonnatives and natives overlap, indicating competition, but in wet periods, isotopic niches will diverge significantly as an indicator of resource partitioning. SIA of museum specimens offers the potential to test key hypotheses about the impact of non-native species on an endemic fauna, and provide understanding of the environmental context that non-native species negatively impact native fishes. Such understanding is important now more than ever for conservation of the Gila River, where climate change and pending water diversion could lead to further decline of native fish abundance and eventual extirpation.

## 2 Nonnative trout removal in a tributary stream: does it benefit native fish in the mainstem Colorado River?

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Oral Presentation

Nonnative fish pose a serious risk to the viability of native fish within the Colorado River. Within the Colorado River through Grand Canyon most of the remaining native fish are thought to rely on the unregulated tributaries for reproduction and recruitment. Unfortunately, so do nonnative trout. Bright Angel Creek, a tributary to the Colorado River (RM 87), has historically been known for its nonnative populations of Brown Trout and Rainbow Trout. Despite sporadic nonnative trout removal since 2002, the National Park Service launched an intensive-five year project in 2012 to remove these nonnative predators within Bright Angel Creek as well as in the mainstem Colorado River at its confluence (RM 80-90). In addition to these focused efforts at Bright Angel Creek, Arizona Game and Fish Department (AGFD) has utilized boat electrofishing twice yearly for long-term monitoring of the Colorado River fish community since 2002. We used data from AGFD's long term monitoring to assess the mechanical removal efforts in this river reach. Excitedly, the fish composition at the confluence has switched from a nonnative to a native fish-dominated community. The native Flannelmouth Sucker has replaced the Brown Trout as the most common fish captured. Interestingly, the size structure of the remaining trout has increased over the last few years. These results demonstrate native fish communities in a large river may benefit from intensive nonnative mechanical removal efforts in a smaller, tributary stream.

## 54 Assessment of time-lapse trail cameras to monitor angler use on Arizona lakes and streams

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Oral Presentation

A fishery is comprised of three primary components: habitat, biota, and human users. In order to manage fisheries effectively, accurate data on angler use are needed to drive sound management recommendations. Angler use data are most commonly gathered using in-person creel surveys; a technique that gathers accurate angler data but can be expensive and time-consuming (especially for projects with limited resources). Therefore, the goal of this project was to evaluate the efficacy of using time-lapse trail cameras to assess angler use on Arizona waters. Trail cameras were placed on five different waterbodies from 2013 to 2016: Fain Lake near Prescott (October 2013 to January 2014), Rose Canyon Lake near Tucson (November 2013 to March 2014), Silver Creek near Show Low (September 2013 to December 2013), Bass Tank near Bagdad (August 2015 to November 2015) and Lake Pleasant (in use; December 2015 to May 2016). The objective was to place cameras to cover waterbodies characteristic of those present over the state (Large reservoir- Lake Pleasant, small to medium reservoir- Rose Canyon and Fain Lakes, stream- Silver Creek, and rural pond- Bass Tank). In-person creel surveys were conducted concurrently on all waterbodies (with the exception of Bass Tank) to compare angler use data to camera counts. We found that trail cameras worked most effectively and gathered more accurate data at smaller waterbodies with limited access points for anglers. Overall, time-lapse cameras appear to be an excellent alternative to in-person creel surveys under certain circumstances.

## 29 Evaluation of current versus alternative sampling methods of Rio Yaqui fishes using gee funnel minnow traps

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Oral Presentation

Population assessments of endangered small-bodied fishes can be challenging because factors governing abundance may also affect detection, biasing observed counts and reducing reliability and precision of abundance estimates. Presently, a relative abundance index for estimating abundance of the Beautiful Shiner, Yaqui Chub, and Yaqui Topminnow endemic to the Rio Yaqui, yet confined to ponds, fails to incorporate detection, resulting in the need to revise the method. We began by using resampling procedures on past relative abundance to evaluate precision and sample size requirements. We determined number of trap deployments needed to achieve a relative standard error (RSE) of 25%. We also examined the effects of alternative soak times (2 versus 4 hr) on precision and abundance using a crossover experimental design, and estimated total abundance and evaluated site-scale correlates of abundance (e.g., net depth, water temperature, and vegetation cover) corrected for detectability using hierarchical Bayesian mixture models. Data simulations enabled us to evaluate relationships between detection, statistical power and Type I error rate. We found that the median RSE of historical samples was generally >25% for Yaqui Chub and Yaqui Topminnow. The number of trap deployments was

positively associated with the number of fish collected and the coefficient of variation. For example, the median effort to achieve an RSE of 25 ranged from 24-39 and 19-52 trap deployments for Yaqui Chub and Yaqui Topminnow. Catch rates differed between species and soak time. Detection estimates ranged from 5% to 83%, and estimated total abundance was variable among species. Modeling results suggested that Rio Yaqui fishes were primarily influenced by depth, temperature, vegetation and soak duration. For example, detection probability decreased with increasing net depth even though Beautiful Shiner was more abundant in deeper depths. Lastly, simulations indicated that statistical power decreased and Type-I error rate increased with varying detectability. Informative estimates of abundance occur with the appropriate number of nets (25 nets/ pond) and 4 hr soak duration. Our results demonstrate relationships between fish detectability, and the implications for not accounting for the detection process when using the relative abundance index. Understanding relationships between fish abundance, depth and vegetation improve habitat management and recovery planning for these endangered species.

## 53 Effect of length-based harvest regulations for trophy and recreational Ictalurus fisheries

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Oral Presentation

Management of blue catfish *Ictalurus furcatus* and channel catfish *I. punctatus* for trophy production has recently become more common. Often this has been attempted with length-specific bag limits that allow moderate harvest of small fish but restrict harvest of large fish. However, the specific regulations used vary considerable across populations and there has been little evaluation of their effectiveness. We used simulation modeling to compare total yield, trophy biomass, and sustainability (spawning potential ratio, SPR, > 0.3) of populations of blue catfish and channel catfish under their current regulation (typically a size-structured size limit), the optimal minimum length regulation, and the optimal size-specific trophy regulation (optimal defined as the limit that maximized yield, trophy biomass, and sustainability). There was no difference in the trophy biomass produced among the current, minimum length, and size-specific bag regulations. Minimum length and size-specific bag regulations produced greater yield and maintained sustainability at higher exploitation rates than current regulations. Minimum length and size-specific regulations produced similar yield and SPR for channel catfish and similar yield for blue catfish, but minimum length regulations produced greater SPRs than size-specific limits for blue catfish. Overall, there was greater variation in yield, trophy biomass, and SPR among populations than there was among regulations used in any given population, suggesting that population-specific regulations may be preferable to regulations applied to geographic regions. We conclude that size-specific limits are useful for producing high yield and sustainability without overly restricting harvest, but they are no more effective than minimum length regulations for producing trophy biomass in most systems.

**81 Comparison of AFS standard snorkeling techniques to eDNA sampling techniques**

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Oral Presentation

Environmental DNA (eDNA) is a new technique used to detect invasive species in aquatic environments through water samples. We compared the efficacy of eDNA methodology to American Fisheries Society standard snorkeling surveys to detect presence of a rare fish species. Our study site included three streams on the Navajo containing the Navajo Nation Genetic Subunit Bluehead Sucker *Catostomus discobolus* and the Zuni Bluehead Sucker *Catostomus discobolus yarrowi*. To determine sample sites, I first divided entire wetted area of streams into 100-m consecutive reaches. I systematically selected 10 of those reaches for snorkel and eDNA surveys. Water samples were taken in 10-m sections within each 100-m reach, and fish presence via snorkeling was noted in each 10-m section as well. A qPCR was run on each individual water sample in quadruplicate to test for sucker presence or absence. I was able to positively detect both species with eDNA sampling techniques in two out of three streams. Snorkeling resulted in positive detection's of both species in all three streams. In streams where fish were detected with eDNA sampling, snorkeling detected fishes at 11-29 sites per stream, where as eDNA detected fish at 3-12 sites per streams. My results suggested that AFS standard snorkeling was more effective at detecting target fish species than eDNA. To improve eDNA sampling, the amount of water collected and tested should be increased. Additionally, filtering water on site may improve eDNA techniques for detecting fish. Future research should focus on standardizing eDNA sampling to provide a widely operational sampling tool.

**1 Can we determine age and growth of warmwater fish in a coldwater river?**

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Oral Presentation

Accurate estimation of age and growth rates are vital information for fishery management. The construction of Glen Canyon Dam and subsequent release of cold hypolimnetic water from Lake Powell have drastically lowered the water temperature of the Colorado River, negatively affecting the growth of the warmwater native and nonnative fishes. In 2013 we began collecting Common Carp dorsal spines for aging and determining growth rates in fish captured from a backwater upstream of Lees Ferry and the mainstem Colorado River. Two readers aged spine sections by marking annuli on images. We found several discrepancies between readers. Exact agreement was only 8.1% and 27.3% in the Lees Ferry backwater and mainstem Colorado River, respectively. Reader inconsistencies as well as recapture data from PIT tagged fish suggests that aging warmwater fish species in a nutrient devoid, cold, relatively stable temperature regime is not accurate. The results of our study could provide insight on the accuracy and practicality of aging warmwater native fishes of the Colorado River such as Flannelmouth Sucker, Bluehead Sucker and the endangered Razorback Sucker and Humpback Chub.

**4 Current status of small-bodied fishes in the San Juan River, New Mexico and Utah**

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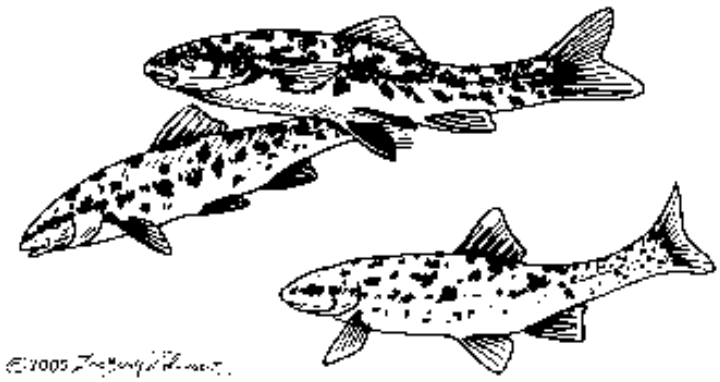
Oral Presentation

The San Juan River downstream of Bloomfield, New Mexico historically supported at least six native fish species. Since the early 1900s, anthropogenic modifications to the system have significantly altered the river's fish community and have proven detrimental to native species. Two of these species, Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus*, are currently listed as federally endangered and a third, Roundtail Chub *Gila robusta*, is considered rare. In an attempt to aid in the recovery of these species, management actions such as mechanical removal of nonnative fish, habitat restoration, and natural flow regime mimicry began in the late 1990s and continue to this day. A concurrent monitoring program was implemented to assess the effects of these activities on the fish community as a whole and evaluate the recovery of Colorado Pikeminnow and Razorback Sucker. Monitoring of small-bodied fishes in primary and secondary channels of the San Juan River is a component of this monitoring program and is designed to document the recruitment of both endangered species, assess survival of stocked age-0 Colorado Pikeminnow, and track trends of native and nonnative fish species. Thus far, small-bodied fish monitoring has failed to capture any wild age-0 Razorback Sucker but did capture a single wild-spawned Colorado Pikeimnnow for the first time in 2015. Densities of other native fish species have remained relatively stable over time. In order to document native fish community changes and detect recruitment of endangered species, monitoring of small-bodied fishes in the San Juan River will be continued for the foreseeable future.



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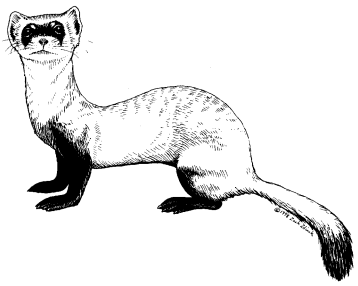

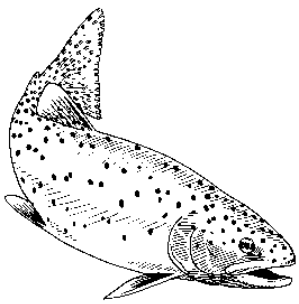

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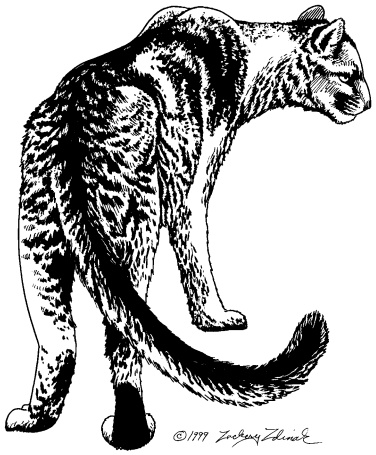

# Notes

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