



UTAH CHAPTER OF THE WILDLIFE SOCIETY

ANNUAL MEETING PROGRAM

St. George, Utah

March 19th – 21st, 2014

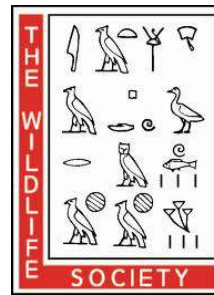
UTAH CHAPTER OF THE WILDLIFE SOCIETY

1965-2014

ANNUAL MEETING

St. George, Utah

March 19th – 21st, 2014



UTAH CHAPTER BOARD MEMBERS:

Randy Larsen, President
Carmen Bailey, Past-President
Chris Wood, President-Elect
Heather Talley, Secretary
Justin Shannon, Treasurer
Covy Jones, Odd-Year Member
Robbie Knight, Even-Year Member
Avery Cook, Webmaster

Lexington Hotel and Conference Center

850 Bluff Street
St. George, Utah 84770
435-628-4235

OVERVIEW OF 2014 TWS MEETING

Wednesday, March 19 th		
6:15 AM	Field Trips	See TWS Website for Details
11:00 AM	TWS Registration	Lexington Hotel and Conference Center
1:00 PM	Welcome to TWS Meeting – Chris Wood	
1:15 PM	Welcome to St. George – Alan Gardner	
1:30 PM	Opening Remarks – Greg Sheehan	
1:45 PM	Invited Speaker – Brian Cook	
2:45 PM	BREAK	
3:15 PM	Invited Speaker – Bill Fenimore	
4:15 PM	Invited Speaker – Dr. Zach Lowe	
5:15 PM	Adjourn until evening events	
6:30 PM	TWS Social	
7:00 PM	Quiz Bowl	

Thursday, March 20 th			
8:00 AM	TWS Registration	Lexington Hotel and Conference Center	
8:45 AM	Announcements and TWS Business		
9:00 AM	Technical Session		
10:15 AM	BREAK		
10:45 AM	TWS Business		
11:00 AM	Technical Session		
12:00 PM	LUNCH		
1:30 PM	Technical Session		Poster Session and Photo Contest in Outside Tent
3:00 PM	Poster Session/Photo Contest		
5:00 PM	Adjourn until evening events		
6:00 PM	Awards Banquet		

Friday, March 21 st		
8:00 AM	TWS Registration	Lexington Hotel and Conference Center
8:30 AM	Announcements and TWS Business	
8:45 AM	Technical Session	
9:30 AM	BREAK	
10:00 AM	Technical Session	
11:00 AM	Meeting Adjourn	



UTAH CHAPTER OF THE WILDLIFE SOCIETY, 2014 PLENARY SESSION

The rapid urbanization of western communities creates new challenges for wildlife managers. This conference will provide a chance to reflect on these challenges and how managers can successfully conserve and manage wildlife while serving an increasingly diverse and eclectic public. Our plenary session this year will consist of three distinguished individuals who will speak to the theme “across the urban-rural divide: managing wildlife for an eclectic public”.

Brian Cook is the owner of Humphries Archery based in American Fork, Utah. Brian has over 25 years’ experience in the bow hunting industry and has perfected his archery skill set by spending countless hours in the field, repetitively shooting and teaching others how to do the same. His distinguished abilities and immense knowledge as an archer earned him the responsibility of coordinating Utah’s first, city-managed urban deer control program in Highland, Utah. He was responsible for overseeing and implementing the City of Highland’s pilot deer management plan by establishing a small team of certified urban bow hunting specialists, targeting problem deer and strategically harvesting them with extreme precision. Brian is considered a pioneer in helping to mitigate the urban-rural divide by managing deer populations within city limits in a very safe, effective and beneficial manner.



Photo Credit: Robbie Knight

Bill Fenimore is an author, educator, naturalist, columnist and field birder, affiliated with Wild About Birds Nature Center. Author of the *Backyard Birds of Utah*, Bill writes a weekly *Bird Sighting* column for the Salt Lake Tribune. Bill has received numerous awards including the 2008 American Birding Association's (ABA) national Ludlow Griscom



Award, ABA's highest and most prestigious honor for outstanding contributions in Regional Ornithology. He has also been the keynote speaker at the Great Salt Lake Bird Festival and St. George Winter Bird Festival. Utah Governor, Gary Herbert appointed Fenimore and the Utah Senate confirmed his appointment to the Governor's Council on Balanced Resources. Utah Governor, Jon Huntsman appointed Fenimore Vice Chair to the Utah Division of Wildlife Resources (DWR) Wildlife Board. Fenimore has also served as Vice Chair of DWR's Northern Regional Advisory Council, 2001-2008. Utah Audubon Council Policy Advocate, 2005-2009 and is a board member of the Swaner Eco-Center in Park City, UT.



Dr. Zach Lowe is director of the national Conservation Leaders for Tomorrow (CLfT) program supported by the Max McGraw Wildlife Foundation and Wildlife Management Institute. CLfT focuses on hunting awareness and conservation education among academic programs and government agencies. Zach is responsible for the implementation and further development of this national

education program dedicated to conservation and hunting awareness among current and future natural resources professionals. Zach is also an adjunct professor in the Department of Forestry and Natural Resources at Purdue University where he worked in extension on the applied science of natural resources as it relates to private, state, and federal land management interests.



UTAH CHAPTER OF THE WILDLIFE SOCIETY

St. George, Utah 2014

DETAILED MEETING SCHEDULE

Wednesday, March 19 th		
9:30 AM 10:00 AM	Field Trips Tour of Red Cliffs Desert Reserve Lytle Ranch birding with Rick Fridell	See Website for Specific Details
11:00 AM	TWS Registration	Lexington Hotel and Conference Center
1:00 PM	Welcome to TWS Meeting Chris Wood – TWS President Elect	
1:15 PM	Welcome to St. George Alan Gardner – County Commissioner, Washington County, Utah	
1:30 PM	Opening Remarks Greg Sheehan – Director, Utah Division of Wildlife Resources	
1:45 PM	Across the Urban-rural Divide: Managing Wildlife for an Eclectic Public Brian Cook – Owner, Humphries Archery	
2:45 PM	BREAK	
3:15 PM	The New and Changing Face of Wildlife Recreation Bill Fenimore – Utah Wildlife Board and Wild About Birds Nature Center	Lexington Hotel and Conference Center
4:15 PM	Conservation and Hunting Awareness: Applications to an Urban Interface Dr. Zach Lowe – Director, Conservation Leaders for Tomorrow	
5:15 PM	Adjourn until evening events <i>Dinner on your own</i>	
6:30 PM	TWS Social – Light refreshments and appetizers	
7:00 PM	Utah TWS Quiz Bowl Frank Howe and Brock McMillan	

Thursday, March 20th

8:00 AM	TWS Registration	Lexington Hotel and Conference Center
8:45 AM	Announcements and TWS Business Randy Larsen – TWS President	
9:00 AM	Eric Edgley and Gary L. Ogborn UDWR AND GIS TECHNOLOGY: MAPPING WITH A STRATEGY	
9:15 AM	Ben J. Sutter, Carmen L. Bailey, and Gary L. Ogborn WESTERN GOVERNORS' CRUCIAL HABITAT ASSESSMENT TOOL (CHAT): MAPPING FISH AND WILDLIFE ACROSS THE WEST	
9:30 AM	David K. Dahlgren, Terry A. Messmer, and Randy T. Larsen GREATER SAGE-GROUSE SEASONAL MOVEMENTS AND EVALUATION OF UTAH'S SAGE GROUSE MANAGEMENT AREAS	
9:45 AM	J. Kalon Throop and Frank P. Howe AN EVALUATION OF THE CONSERVATION STATUS OF THE GRASSHOPPER SPARROW IN UTAH	
10:00 AM	Eric D. Freeman, Randy T. Larsen, and Brock R. McMillan SELECTION OF SITES FOR PARTURITION BY MULE DEER IN SOUTHERN UTAH	
10:15 AM	BREAK	
10:45 AM	Report on TWS Council Activities Dr. Gary White – Board Member, TWS National	Lexington Hotel and Conference Center
11:00 AM	Amanda Christensen and Michael J. O'Farrell CONTRIBUTION TO THE DISTRIBUTION OF WESTERN RED BAT (<i>LASIURUS BLOSSEVILLII</i>) BASED ON ACOUSTIC MONITORING STATIONS	
11:15 AM	Avery Cook, Terry Messmer, Seth Dettenmaier, and Brian Wing EFFECTS OF CAPTURE AND HANDLING ON GREATER SAGE-GROUSE (<i>CENTROCERCUS UROPHASIANUS</i>) ADULT SURVIVAL AND REPRODUCTIVE SUCCESS IN NORTHWEST UTAH	
11:30 AM	Ann M. McLuckie, Meribeth Huizinga, and Richard A. Fridell DESERT TORTOISE OCCUPANCY ESTIMATION WITHIN THE RED CLIFFS DESERT PRESERVE	
11:45 AM	Pat Terletzky and David N. Koons ADVANCES IN DEVELOPING A SIGHTABILITY MODEL FOR BISON WITH GPS COLLARS	
12:00 PM	LUNCH <i>On your own</i>	
1:30 PM	Raul S. Lira and Michael L. Wolfe WILDLIFE MANAGEMENT ISSUES AT THE END OF THE WORLD	Lexington Hotel and Conference Center
1:45 PM	Kyle C. Nehring, Kari E. Veblen, and Tamara J. Zelikova LARGE UNGULATE EFFECTS ON SAGEBRUSH PLANT COMMUNITIES: IMPLICATIONS FOR MAINTAINING VITAL FORAGE HABITAT FOR MULTIPLE UNGULATE SPECIES	
2:00 PM	John R. Taylor, Zachary A. Warren, and Tagert Smith ESTABLISHING ECO-REGIONAL BASELINE BAT DATA AT CEDAR BREAKS, BRYCE CANYON, AND ZION NATIONAL PARK UNITS	

Thursday, March 20th Continued

2:15 PM	<p>Theresa Pope 20-YEAR TRENDS FOR RIPARIAN BIRDS IN UTAH</p>	Lexington Hotel and Conference Center
2:30 PM	<p>Michael R. Guttery, David K. Dahlgren, Terry A. Messmer, John W. Connelly, Kerry P. Reese, Pat A. Terletzky, Nathan Burkepile, and David N. Koons EFFECTS OF LANDSCAPE-SCALE ENVIRONMENTAL VARIATION ON GREATER SAGE-GROUSE CHICK SURVIVAL</p>	
2:45 PM	<p>TWS Business Justin Shannon, Treasurer</p>	
3:00-5:00 PM	POSTER SESSION/PHOTO CONTEST	
Poster Session and Photo Contest	<p>David C. Smedley, Randy T. Larsen, and Brock R. McMillan DIFFERENCES IN SURVIVAL AND MOVEMENT OF TRANSLOCATED AND RESIDENT MULE DEER IN CENTRAL UTAH</p> <p>Hope Braithwaite, Tim Bateman, Juan Villalba, Kari Veblen, and Eric Thacker IDENTIFICATION OF DIET SUPPLEMENTS FOR ELK MANAGEMENT</p> <p>Rusty Robinson, Tom Smith, and Justin Shannon DETERMINING THE STATUS AND TREND FOR DESERT BIGHORN SHEEP IN THE NORTH SAN RAFAEL SWELL</p> <p>Jace C. Taylor, Steven Bates, Jericho C. Whiting, and Randy T. Larsen ESTIMATING POPULATION SIZE OF ROCKY MOUNTAIN BIGHORN SHEEP: A COMPARISON OF MULTIPLE MARK-RESIGHT METHODS</p> <p>Jamie Reynolds and Phaedra Budy EFFECTS OF WATER QUALITY ON FISH SPECIES IN CUTLER RESERVOIR</p> <p>Jacob T. Hall, Lucas K. Hall, Randy T. Larsen, Robert N. Knight, and Brock R. McMillan DO SUBORDINATE CARNIVORES ALTER TEMPORAL AND SPATIAL ACTIVITY TO REDUCE COMPETITION WITH DOMINANT CARNIVORES AT WATER SOURCES?</p> <p>Tiffany R. Sharp and Brock R. McMillan SHORT-TERM DIRECT AND INDIRECT EFFECTS OF FIRE ON DESERT SMALL MAMMALS</p> <p>Connor T. Lambert, Lucas K. Hall, Randy T. Larsen, Robert N. Knight, and Brock R. McMillan COMPETITION AMONG DESERT BATS AT WATER SOURCES: INFLUENCE OF SURFACE AREA AND HABITAT COMPLEXITY</p> <p>Adam Kavalunas and Tonie Rocke SYLVATIC PLAGUE VACCINE: A NEW TOOL FOR CONSERVATION OF THREATENED AND ENDANGERED SPECIES?</p> <p>Joseph C. Barnes and Steven J. Slater PEREGRINE FALCONS AS IDEAL MERCURY BIOMONITORS</p>	Lexington Hotel and Conference Center (outside tent)
3:00 – 5:00 PM		

Thursday, March 20th Continued

	<p>Suzanne Dunken, Peter J. Maughn, Rick J. Baxter, Brock R. McMillan, and Randy T. Larsen INFLUENCE OF TRANSLOCATION ON GREATER SAGE-GROUSE IN STRAWBERRY VALLEY, UTAH: HAS GENETIC DIVERSITY INCREASED FOLLOWING AUGMENTATION?</p> <p>Wesley Larson, Tom S. Smith, Jon Kirschhoffer, and Steven C. Amstrup USING SYNTHETIC APERTURE RADAR FOR DETECTION OF POLAR BEAR DENS</p> <p>Steven Sims, David Stoner, Thomas Edwards, Jyothy Nagol, Joseph O. Sexton, Kirsten E. Ironside, David J. Mattson, David M. Choate, and Kathleen Longshore MOUNTAIN LION (<i>PUMA CONCOLOR</i>) HOME-RANGE SIZE AND THE NORMALIZED DIFFERENCE VEGETATION INDEX: USING A LANDSCAPE PRODUCTIVITY INDEX AS A SURROGATE FOR PREY DENSITY</p> <p>Natalie Schvaneveldt and Leah Lewis ANALYSIS OF MEXICAN SPOTTED OWL DIET IN THE CANYONLANDS OF SOUTHERN UTAH</p> <p>Julie Miller, Tom S. Smith, Janene Auger, Hal Black, and Loreen Allphin AN ANALYSIS OF BLACK BEAR (<i>URSUS AMERICANA</i>)—HUMAN CONFLICT IN UTAH</p> <p>Jared J. Baxter, Rick J. Baxter, and Randy T. Larsen GREATER SAGE-GROUSE CHICK SURVIVAL USING LUKAC'S MODEL IN PROGRAM MARK</p> <p>Shane Hill and Frank P. Howe ANALYSIS OF MORPHOMETRIC CHARACTERISTICS FOR SEX DETERMINATION OF THE EURASIAN COLLARED-DOVE IN THE FIELD</p> <p>Tom S. Smith, John Gookin, Bryan Hopkins, and Samantha Henrie PORTABLE ELECTRIC FENCING FOR BEAR DETERRENCE AND CONSERVATION</p> <p>Skylar Y. Farnsworth, Chase B. Allred, M. Brandon Flack, Shane A. Hill, Natalie A. Schvaneveldt, Arthur C.E. Wallis, and Karen H. Beard FROGGER, GAME OVER: ROADS REDUCE FROGS ACROSS THE EASTERN UNITED STATES</p> <p>R. Justin Bingham, Randy T. Larsen, Jason Robinson, and Frank P. Howe IMPACT OF COHORT SIZE, REARING TYPE, AND WATER AVAILABILITY ON SITE FIDELITY AND SURVIVAL OF TRANSLOCATED CHUKARS</p>
Poster Session and Photo Contest	
3:00 – 5:00 PM	

Lexington Hotel and Conference Center
(outside tent)

Thursday, March 20th Continued

Poster Session and Photo Contest 3:00 – 5:00 PM	Jay W. Olson, Karyn Rode, Dennis Eggett, Tom S. Smith, and Dave Douglas IDENTIFYING MATERNAL DENNING BEHAVIOR IN POLAR BEARS USING TEMPERATURE Kristen S. Ellis, Allison M. Peters, Keeli S. Marvel, Robert J. Delph, Robert N. Knight, Joseph R. Jehl, Jr., and Randy T. Larsen OBSERVATIONS ON A SPRING DOWNING OF EARED GREBES AT DUGWAY PROVING GROUND, UTAH	Lexington Hotel and Conference Center (outside tent)
6:00 PM	Awards Banquet and Raffle (Sponsors below) Tom Smith	Lexington Hotel and Conference Center



Friday, March 21st

8:00 AM	TWS Registration	Lexington Hotel and Conference Center
8:30 AM	Announcements and TWS Business Carmen Bailey – Past President	
8:45 AM	David Stoner, Thomas Edwards, Joseph O. Sexton, Jyothy Nagol, and Heather Bernales UNGULATE REPRODUCTION AND PLANT PHENOLOGY ON THE COLORADO PLATEAU	
9:00 AM	David K. Dahlgren, Michael R. Guttery, Terry Messmer, and David N. Koons GREATER SAGE-GROUSE RETROSPECTIVE AND PROSPECTIVE POPULATION DYNAMICS ON PARKER MOUNTAIN, UTAH	
9:15 AM	Jason D. Cox, Kevin Gunnell, and Frank P. Howe THE RELATIONSHIP OF BULBOUS BLUEGRASS AND BIG SAGEBRUSH AND THE POTENTIAL IMPLICATIONS FOR SHRUBSTEPPE WILDLIFE IN UTAH	
9:30 AM	BREAK	
10:00 AM	Lucas K. Hall, Randy T. Larsen, Matthew D. Westover, Casey C. Day, Robert N. Knight, and Brock R. McMillan EXOTIC HERBIVORE INFLUENCES WILDLIFE COMMUNITY USE OF A SCARE RESOURCE IN A SEMI-ARID ENVIRONMENT	Lexington Hotel and Conference Center
10:15 PM	Julie Miller, Josh Heward, Janene Auger, Tom Smith, Hal Black, John Shivik, Craig Clyde, Dale Liechty, Wade Paskett, Riley Peck, Guy Wallace, Randall Thacker, Brad Crompton, and Justin Shannon MAMMALIAN SPECIES SEEN AT FEMALE BLACK BEAR DENS: RANDOM OR NON-RANDOM DEN VISITORS?	
10:30 AM	Steven J. Slater, Joseph G. Barnes, Shawn E. Hawks, and M. David Oleyar EMERGING RAPTOR MONITORING PROJECTS AT HAWKWATCH INTERNATIONAL	
10:45 AM	Joel S. Ruprecht, Daniel R. MacNulty, and Kent R. Hersey DEMOGRAPHIC CHARACTERISTICS OF UTAH MOOSE: THE EDGE OF THE RANGE	
11:00 AM	Meeting Adjourn	

UTAH TWS BOARD

CANDIDATES FOR ELECTION

PRESIDENT

ALLISON JONES – Allison currently serves as the Executive Director of Wild Utah Project. Though born and raised in California (B.A in Environmental Studies at U.C. Santa Cruz under the guidance of her mentor and advisor, Michael Soule) she left as soon as she could after graduation. Her path to Utah took her through Reno (M.S in Conservation Biology at UNR) and Denver where she took up with an ecological consulting firm. She and her now-husband made their way to Utah - without jobs - for the rock climbing and skiing, and are still here almost 16 years later. After a quick stint at BioWest in Logan, Allison settled into Wild Utah Project as the staff Conservation Biologist and is still there. At Wild Utah Project she has provided needed biological analyses for other Utah conservation groups (things like status reviews of rare species, and ecological analyses of various federal land management plans and actions), and has conducted various research projects and analyses ranging from Least Cost Path analyses for lynx to the investigation of the interaction of livestock grazing and mechanical sagebrush treatment at Kennecott Utah Copper. Allison has been appointed to UDWR working groups to revise or write wildlife conservation and management plans (Black Bear In 2000 and Wolf in 2004) and currently sits on the state's Sage-grouse Plan Implementation Council.

KEVIN LABRUM – Kevin grew up in the Salt Lake Valley and from an early age he was intensely interested in nature, spending his days engaged in activities like bird watching, collecting insects, catching herps and reading about wildlife. He received his B.S. degree in Biology from Utah State University. While at USU, Kevin worked in seasonal and part time jobs for professors, graduate students, the UDWR, the Predation Ecology Lab, the Pollination Ecology Lab, the Forest Service, and the Fish Ecology Lab. In these jobs he worked with a variety of wildlife, fish, and insect species. While working at the Pollination ecology lab, Kevin's undergraduate research project was selected as one of 60 projects nation-wide to present a poster to congress in Washington DC at "Posters on the Hill." Upon graduating, he was torn between graduate studies in wildlife and entomology, receiving assistantship offers in both disciplines. Ultimately choosing wildlife, He graduated with an M.S. from Arkansas Tech in Wildlife Biology where he studied bobwhite quail for his thesis. While finishing his thesis, Kevin joined the U. S. Fish and Wildlife Service in the Arkansas Field Office working on ESA listed species before transferring for a 4 month stint on the Lower Rio Grande Valley National Wildlife Refuge as their Oil and Gas Wildlife Biologist. He was glad to come back home to Utah to work for the UDWR as the Northern Region Sensitive Species Biologist for almost 2 years. Kevin is currently a wildlife biologist for the U.S. Forest Service on the Logan and Ogden Ranger Districts and has been in this position for 4 ½ years. In his spare time, Kevin enjoys hunting, fishing, gardening and cooking.

EVEN YEAR BOARD MEMBER

BRANDON BEHLING – Brandon is the Support Services Coordinator for the Southeastern Region of the Utah Department of Wildlife Resources (UDWR). Originally from Ferron, Utah commonly known as God’s Country, he received his bachelor’s degree at Southern Utah University in Accounting. Brandon worked in the private sector developing business models, managed small businesses, and worked in the customer service and financial sectors for a major corporation. After spending eight years climbing the orange corporate ladder at The Home Depot, Brandon saw the light, packed up his family and left the retail world behind to become a Financial Analyst for UDWR. Eight months later Brandon packed up his family once again and moved back to Ferron accepting his current position with UDWR. When not at work, Brandon can be found fishing, hiking, hunting, camping, refining his photography skills, or just spending time with his family in the great outdoors.

TREASURER

BLAIR STRINGHAM – Blair has been working for the Utah Division of Wildlife Resources since 2004 as a Waterfowl Technician, Sage Grouse Biologist, District Biologist, and currently as the Migratory Game Bird Coordinator. He oversees the management of waterfowl, cranes, band-tailed pigeons, and doves in Utah. He received his BS in Wildlife Science and MS in Wildlife Biology from Utah State University. Blair lives in Box Elder County with his one wife, three kids, and two dogs. When he's not hunting ducks, Blair enjoys camping, hiking, fishing, and watching college football, but not necessarily in that order.

JEANINE SAIA -- Jeanine lives in Moab, Utah. She has worked as a wildlife biologist previously and is currently working as a bookkeeper, in charge of finance, budget, A/P, A/R, and payroll. She graduated from Humboldt State University in 1994 with a BS in Wildlife Management. She has participated in many research projects around the west from 1991-2000. The projects that most interested Jeanine were in conservation; she has hooted for owls, trapped and tagged carnivores, counted Chinook, and identified songs of migrating birds. She has also worked in the oil fields surveying and searching for fox and raptors, which were also valuable experiences that allowed her to make management recommendations, writing up technical reports. She currently works as a bookkeeper, taking valuable lessons of owning her own business with her. She conducts payroll, accounts payable, accounts receivable, budget projections, fiscal planning, and collects all funds at events. She helps host a local four day event twice a year that generates cash flow from some 1500 customers. She is familiar with how small businesses work, paying the bills, raising revenue when times are tight, and brain storming for future projects.

SECRETARY

NATASHA GRUBER – Natasha was born and raised near Big Birch Lake in Minnesota. She received her B.S. degree in Biology from Minnesota State University Moorhead. After graduating, she spent a year in the Dominican Republic teaching kids to read and write in Spanish. She then came back to the U.S. and did multiple wildlife technician jobs in Minnesota (painted turtles, wild turkeys, prairie chickens, and ruffed grouse), North Dakota (prairie dogs and yellow-headed blackbirds), Texas (northern bobwhite quail), Colorado (greater sage-grouse and sharp-tails), South Dakota (prairie chickens, pheasants, and sharp-tailed grouse) and Utah (black-footed ferrets, ferruginous hawk, pika, big-horned sheep, prairie dogs, various bird and bat species, and sage-grouse). Natasha then completed her M.S. degree in Wildlife Biology at Utah State University. She studied the population dynamics and habitat uses of translocated and resident greater-sage grouse on Anthro Mountain in northwestern Utah. Currently, Natasha works as a Sage Grouse Initiative Biologist in Utah with the Natural Resources Conservation Service (NRCS) and the Mule Deer Foundation, working with ranchers to improve habitat for sage-grouse and their livestock operations. Natasha also enjoys hunting, kayaking, birding, and reading a good book.

JESSICA VAN WOEART – Jessica is currently the administrator for the Iron County Habitat Conservation Plan for the Federally threatened Utah prairie dog with the Utah Division of Wildlife Resources. Prior to her current position she worked seasonally with the UDWR for two years as a wildlife technician working with the Utah prairie dog and assisted a PhD student studying the effects of mesocarnivores on the Eastern turkey population in Texas. She received her B.S. in Wildlife Science from the State University of New York College of Environmental Science and Forestry. Jessica is not only passionate about wildlife, in her free time she volunteers with canines at a local animal rescue and serves on the board of a non-profit organization, Friends of Festival Country K-9s, to help promote responsible dog ownership, aide shelters with adoption events and provide educational outreach to the community.



Meeting Abstracts

UDWR AND GIS TECHNOLOGY: MAPPING WITH A STRATEGY

Eric Edgley, Gary L. Ogborn

Utah Division of Wildlife Resources, Salt Lake City, UT 84114

Geographic Information System (GIS) tools have been in use in DWR for over two decades to track location data, map animal distributions, and perform basic spatial analysis. Many successful data collection and map products have been produced over the years; however, existing personnel have been stretched to their limits due to extremely high demand for ad-hoc maps and services requested to meet immediate needs. Also, GIS software tools and technologies are quickly evolving making it difficult to maintain personnel proficiencies. Through the years, an agency-wide plan and strategy for GIS has never been adopted. But in recent months, division leadership have come to understand the potential contribution of GIS technology to our ability to be more effective and efficient in managing the wildlife resources in the state of Utah. We will present portions of the draft strategic plan that is currently under review, as well as some examples of what we have done so far and some things we plan to do in the future.

WESTERN GOVERNORS' CRUCIAL HABITAT ASSESSMENT TOOL (CHAT):

MAPPING FISH AND WILDLIFE ACROSS THE WEST

Ben J. Sutter¹, Carmen L. Bailey¹, Gary L. Ogborn¹

¹Utah Division of Wildlife Resources, Salt Lake City, UT 84114

Western Governor's Association represents the Governors of 19 Western states and 3 U.S.-flag islands and provides an effective platform for Governors to formulate bipartisan, consensus-based policy positions and to realize those policies through strategic advocacy and implementation. With the launch of the Western Governors' Crucial Habitat Assessment Tool (CHAT), the Western Governors Association aimed to bring greater certainty and predictability to planning efforts by establishing a common starting point for discussing the intersection of development and wildlife. CHAT was designed to reduce conflicts and surprises while ensuring wildlife values were better incorporated into land use decision-making, as well as large-scale conservation projects. To develop CHAT, common definitions of crucial wildlife habitat were adopted and guidelines were issued to help each state prioritize habitat within its boundaries to meet its specific conservation objectives. States compiled data encompassing several categories including species of concern, species of economic and recreational importance, landscape condition, riparian and wetland habitat, and large natural areas. Using a standardized prioritization scheme, states ranked areas as "crucial habitat" from "most crucial" to "least crucial". State data inputs were combined into a GIS map layer using the common Western Governors' framework to create an aggregated Crucial Habitat Layer. This broad-based, collaborative effort across the western states has resulted in a west-wide crucial habitat layer derived from important habitat inputs. Western Governors' Association is now working to make this information on important fish and wildlife habitat compatible across the West and available to the public to inform land use decisions.

GREATER SAGE-GROUSE SEASONAL MOVEMENTS AND EVALUATION OF UTAH'S SAGE-GROUSE MANAGEMENT AREAS

David K. Dahlgren¹, Terry A. Messmer¹, and Randy T. Larsen²

¹Department of Wildland Resources, Utah State University, Logan, UT 84332

²Department of Plant and Wildlife Sciences, Brigham Young University, Provo, UT 84602

The greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) is currently a candidate species for federal protection under the Endangered Species Act. In response to concerns of federal listing, the Utah Governor's Office developed a Conservation Plan for Greater Sage-Grouse in Utah (Plan). The Plan identifies conservation strategies to be implemented over the next decade within 11 Sage-grouse Management Areas (SGMAs). The SGMAs are large landscapes that are currently occupied by sage-grouse and thus afford the greatest potential to protect and enhance sagebrush (*Artemisia* spp.) habitat and ultimately increase populations. Since the late 1990s researchers from Utah State University (USU) and Brigham Young University (BYU) have been conducting telemetry-based research to map the ecology of sage-grouse in Utah populations and their response to management. This research has resulted in the accumulation of over 20,000 sage-grouse seasonal habitat-use spatial data points that were organized into one central database. This database is continually being updated as new research is completed. We used spatial location data from 1998-2013 to map distances from nearest lek to nest and summer brood (June 15-August 31) locations, as well as the maximum distance individual hens moved between their nest and summer brood locations to determine if the Utah SGMAs encompass breeding habitats. We also included analysis for nest and brood locations documented outside of the currently proposed SGMAs. Sage-grouse nests (n=943) average 2.22 km from the nearest lek and the 90th percentile was within 5 km. Maximum distance for individual broods (n=958) averaged 3.71 km from nearest lek and the 90th percentile was within 7.59 km. Movements from nest to brood locations (n=392) averaged 5.67 km, and the 90th percentile was within 13.17 km. There is considerable variation in movement distances between study areas, especially for nest to brood movements, which likely reflects available usable space. Individual sage-grouse in Utah may move considerable distances to meet their seasonal habitat needs. In summary, our data suggests that buffers of 5 km (~3 mi) and 8 km (~5 mi) around leks may be needed to conserve at least 90% of Utah's sage-grouse nesting and brooding habitat, respectively. Of study areas within SGMAs evaluated, 99% of nests and brood locations were contained within the SGMA boundaries. For all nest and brood locations (including study areas outside SGMA boundaries) ~ 85% of nest and brood locations were encompassed by current SGMAs. Nest and brood locations in bordering states (Idaho, Wyoming, and Nevada) were not used to calculate these percentages.

AN EVALUATION OF THE CONSERVATION STATUS OF THE GRASSHOPPER SPARROW IN UTAH

J. K. Throop^{1,2} and F. P. Howe^{1,3}

¹Quinney College of Natural Resources, Utah State University, Logan, UT 84322

²EC Source Services, Rush Valley, UT 84069

³Utah Division of Wildlife Resources, Salt Lake City, UT 84114

The grasshopper sparrow (*Ammodramus savannarum*) has experienced range-wide population decline because of a loss of grassland habitats. The Utah Division of Wildlife Resources listed the grasshopper sparrow as a state sensitive species in 1998 because of limited distribution in Utah and population decreases throughout the western United States. In 2013, we reevaluated the status of the grasshopper

sparrow in Utah by compiling resources showing the current extent and population trend of the grasshopper sparrows. We also developed habitat models designed to aid biologists and managers in grasshopper sparrow conservation efforts. Breeding Bird Survey trends show an apparent leveling out of national and western grasshopper sparrow populations; however, populations have leveled at a lower relative abundance than previously recorded. Using multiple land cover data sources and known observations of birds in Utah, we developed three potential grasshopper sparrow habitat models. These "first cut" models indicate that grasshopper sparrows may have widespread potential habitat in northern Utah. Based on our research, we provide recommendations on whether grasshopper sparrows should remain on the state's Sensitive Species List and discuss future steps for improving the predictive power of our habitat models.

Selection of sites for parturition by mule deer in southern Utah

Eric D. Freeman, Randy T. Larsen, and Brock R. McMillan

Habitat selection by ungulates is influenced by climate, availability and quality of forage, and risk of predation. As female ungulates experience different reproductive stages, the relative influence of these factors on habitat selection likely shifts. In particular, rearing offspring presents females with the challenge of meeting the needs of juveniles for security while satisfying nutritional demand of adults during lactation. Because neonate ungulates are most vulnerable to predation during parturition and shortly thereafter, selecting sites for parturition can have direct fitness consequences. We investigated the selection of parturition sites by mule deer. We utilized vaginal implant transmitters to identify sites of parturition on Monroe Mountain in south-central Utah. We obtained macro- (e.g., topographic and habitat-type parameters) and microhabitat (e.g., horizontal/vertical obscuration and forage abundance) measures at each site of parturition and associated random sites. We then used the classifier random forest to discriminate between use and random sites based on a suite of explanatory variables. At the macrohabitat scale, parturient females selected (on average) higher elevations, increased slopes, reduced ruggedness, decreased topographic visibility, east-facing aspects, reduced conifer cover, and increased oak/mountain brush cover. At the microhabitat scale, selection was most strongly influenced by hiding cover (both horizontal and vertical). In contrast, measures of herbaceous forage did not help discriminate between parturition and random sites. Mule deer appear to select sites for parturition that provide a suitable microclimate and concealment from predators for neonates. These factors are likely more important than forage considerations because sites of parturition are inhabited for a relatively short period of time when neonates are most vulnerable.

CONTRIBUTION TO THE DISTRIBUTION OF WESTERN RED BAT (*LASIURUS BLOSSEVILLII*) BASED ON ACOUSTIC MONITORING STATIONS

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Previously published accounts of the distribution of the western red bat (*Lasiurus blossevillii*) consist primarily of sparse capture points and museum specimen through portions of California, Nevada, Utah, Arizona, and New Mexico. We used zero-crossings (Anabat) echolocation recording technology between 2002 and 2011 to inventory bat species presence at locations throughout the western United States. We

recorded identifiable echolocation calls of western red bat at 52 new locations in five states: Nevada, Utah, Wyoming, Idaho, and Oregon. We present seasonal distributions of the species based on our data and show the species is present in three states that do not currently manage for the species: Wyoming, Idaho, and Oregon. The species distribution in Utah is expanded to Millard, Garfield, and Utah Counties. Acoustic surveys demonstrate that the species occurs farther north and east than previously known both regionally and in Utah. The presence of this species is more easily detected through the use of acoustic survey equipment rather than by capture methods alone.

EFFECTS OF CAPTURE AND HANDLING ON GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*) ADULT SURVIVAL AND REPRODUCTIVE SUCCESS IN NORTHWEST UTAH

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Greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) are a species of increasing conservation concern. Because of declining populations attributed to habitat loss and fragmentation, the US Fish and Wildlife Service has given sage-grouse candidate status under the Endangered Species Act of 1973. Concomitantly, the number of research projects completed has dramatically increased. Sage-grouse research projects typically involve capturing and handling sage-grouse for radio-marking and to record biological information. Few studies have addressed the effects of handling on sage-grouse vital rates, the few published studies focus on chick survival. We captured 205 sage-grouse (69 Male, 145 Female) in northern Utah between January 2012 and March 2013. During capture, handling, and release we collected data on capture crew performance, bird disposition, and signs of stress displayed during and after handling. We subsequently monitored birds using VHF radio telemetry to determine if nest success, brood success and annual survival differed relative to capture and handling characteristics. Degree of roughness during capture ($p=0.04$) influenced the probability of surviving the 19 month study duration, while disposition on release was related to nest survival ($p=0.08$). Propensity to flush, measured as whether or not a bird flushed one or more times prior to capture influenced nest ($p=0.10$), brood ($p=0.01$) and annual survival ($p=0.02$). Study populations typically consist primarily of birds who did not flush during capture attempts. Differential survival between previously flushed and non-flushed birds indicate potential bias in sample populations relative to studied populations. Results also indicate that variations in capture and handling may influence sage-grouse vital rates.

DESERT TORTOISE OCCUPANCY ESTIMATION WITHIN THE RED CLIFFS DESERT RESERVE

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Habitat occupancy was analyzed within the Red Cliffs Desert Reserve in southwest Utah, using a long-term dataset generated from a desert tortoise monitoring study (1998 to 2012). In Management Zone 3, the core of the Reserve, the probability of occupancy was relatively stable during the fourteen years of the study with colonization and local extinction rates relatively constant over time. This finding is expected for a long-lived species such as the desert tortoise with limited long distance movements and high site-fidelity. In Management Zone 2, probability of occupancy increased then stabilized during the study, indicating that

over time tortoises were occupying more habitat patches and colonization was greater than local extinction. Unlike Zone 3, two major sources of mortality, including disease outbreak (i.e., UR TD) and large scale fires, have not been observed in Zone 2. Further, Snow Canyon State Park, which encompasses the majority of habitat in Zone 2, may offer additional regulations and oversight to protect tortoises and their habitat not found in other parts of the Reserve. The stable occupancy estimates within the Reserve are not consistent with other population parameters collected from our long-term monitoring program (e.g., abundance, density). For example, density estimates indicate a biologically significant decline of tortoises since regional monitoring began in 1998. In contrast, the probability of occupancy was stable (i.e., Zone 3), with some areas increasing their probability of occupancy (i.e., Zone 2). Population declines were likely not detected within the occupancy framework because >1 individual continued to occupy the site and was detected at least once per season. This underscores the importance of collecting a suite of desert tortoise population parameters rather than relying on a single population parameter to understand the dynamics of a tortoise population.

ADVANCES IN DEVELOPING A SIGHTABILITY MODEL FOR BISON WITH GPS COLLARS

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The probability of detection is essential for accurately estimating animal population abundance. With the advent of programmable GPS radio-collars, biologists have access to data at resolutions previously unavailable, allowing for the identification of missed animals and duplicate observations during aerial surveys. We equipped 44 bison (*Bison bison bison*) with GPS-collars and documented the spatial and temporal relationship between bison travel paths and annual helicopter survey paths. Using GPS-collar locations, we examined aerial survey results at two resolutions and determined the probabilities of detection (i.e., sightability) and duplicate observations for bison in south-central Utah. Models were developed at survey wide and spatially stratified data resolutions with physiographic and survey variables. Larger group sizes increased the probability of detecting a bison at both data resolutions. As the time increased from the start of the survey and the distance increased from the prior observation, the probability that an observation of a bison was actually a duplicate observation increased. Horvitz-Thompson population abundance estimates for the survey wide data resolution were higher than the spatially stratified data resolution in 2011 and 2102 but were almost identical for 2013. Incorporating known missed bison and duplicate observations into aerial survey counts will result in a more accurate population abundance estimate.

WILDLIFE MANAGEMENT ISSUES AT THE END OF THE WORLD

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The southern cone of South America, loosely termed Patagonia, harbors a diverse indigenous avian and mammalian fauna, including various species of conservation concern. At the same time several exotic species have been introduced, notably European hares and rabbits (*Lepus europaeus*, *Oryctolagus cuniculus*), red deer (*Cervus elaphus*), North American beaver (*Castor canadensis*) and mink (*Mustela vison*). This

juxtaposition poses certain complex wildlife management issues, relative to altered predator-prey systems, conflicts with domestic livestock production and impacts on native vegetation. This paper highlights some of these issues with emphasis on the Magellanic region of southern Chile. We focus on competition between domestic livestock and guanaco (*Lama guanicoe*) and predation on livestock (primarily sheep) by puma (*Puma concolor*) and Andean fox (*Lycalopex culpaeus*) as well as a burgeoning population of beaver on the island of Tierra del Fuego. From six pairs introduced on the Argentinian side of the island in 1947 the population has increased to a conservative estimate of more 100,000 individuals and has pioneered onto the continental mainland with detrimental and probable long-term impacts on southern beech (*Notofagus* spp.) forest ecosystems. The principal impediment to effective management lies in a disconnect between local problems arising from regional overabundance of some nationally sensitive species and a centralized system of wildlife administration, whereby management decisions by federal agencies emanate from the capital city with little regional input. Other problems include a poorly developed tradition of sport hunting and limited markets for animals removed in culling efforts.

LARGE UNGULATE EFFECTS ON SAGEBRUSH PLANT COMMUNITIES: IMPLICATIONS FOR MAINTAINING VITAL FORAGE HABITAT FOR MULTIPLE UNGULATE SPECIES

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Big sagebrush (*Artemisia tridentata*) ecosystems in the intermountain west are vital foraging habitats for elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), and cattle (*Bos primigenius*). Herbivory can drive large changes in plant community dynamics but little is known about how plant communities respond and change to pressure from overlapping large ungulate species. This lack of knowledge places ungulate populations in peril because as elk, mule deer, and cattle populations increasingly overlap forage habitats may change in unpredictable ways. Using a series of long-term wildlife and cattle exclosures (60+ years), we tested how sagebrush plant community composition and structure has responded to three different large ungulate foraging pressures: 1) no ungulate pressure, 2) elk and mule deer foraging pressure, and 3) elk, mule deer and cattle pressure. Initial results show that soil depth largely controlled the variety of plant community compositions possible at a site, while the type of ungulate herbivory determined the ultimate composition and structure of a community. In sites with deeper soils (>75cm) plant community composition was dramatically different between herbivory treatments, ranging from large sagebrush dominated systems with no herbivory, to bunch grass dominated systems when all are ungulates were present. Sites with shallower soils (< 75cm) maintained sagebrush dominated compositions regardless of ungulates present. Although no large compositional differences were observed in the shallower soils, there were observed structural differences between treatments, with cattle increasing recruitment of small sagebrush and wild ungulates decreasing the density of large shrubs. Our results highlight that sagebrush plant community composition is determined by both abiotic (soil depth) and biotic (ungulate herbivory) factors. We recommend that land managers use these results to 1) model how sagebrush habitats will respond to changing ungulate foraging pressures and 2) inform how we might use different foraging strategies to maintain or shift particular plant communities into quality forage habitat.

ESTABLISHING ECO-REGIONAL BASELINE BAT DATA AT CEDAR BREAKS, BRYCE CANYON AND ZION NATIONAL PARK UNITS

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Bats utilizing water sources and visitor-use areas within a variety of habitats inside three southern Utah national parks (Bryce Canyon National Park, Zion National Park, and Cedar Breaks National Monument) were surveyed at 12 sites over the course of a single field season. Pettersson D500X full-spectrum bat detectors were used to acoustically survey a total of 67 nights at 11 of those sites. All 18 species known to occur in Utah were detected either through acoustic recording, capture, or observation. This includes acoustic detection of *Lasiurus blossevillii* at the Bryce Canyon Lodge and the collection of recordings at multiple sites that match parameters for *Eumops perotis*, which have yet to be confirmed as present in Utah. Of the unconfirmed species at Bryce Canyon, this study acoustically recorded the presence of Townsend's big-eared bat (*Corynorhinus townsendii*), and Brazilian free-tailed bat (*Tadarida brasiliensis*). This study was also able to acoustically detect the little brown myotis (*Myotis lucifugus*), a previously unconfirmed species for the park, at Zion's Sawmill Spring.

20-YEAR TRENDS FOR RIPARIAN BIRDS IN UTAH

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Riparian systems make up < 1% of land area in Utah, but riparian systems are arguably the habitat in greatest conservation need. Over 70% of Utah's birds use riparian habitat, yet little was known about population status and trends of these species when Utah DWR initiated a 20-year riparian monitoring project. To get baseline data and evaluate trends, Utah DWR conducted point counts at 37 riparian sites across Utah from 1992 to 2011. I estimated statewide density of 38 species for each year of the study using the Conventional Distance Sampling and Multiple Covariate Distance Sampling (MCDS) engines in DISTANCE. The variable affecting detection that appeared most often in the best-supported MCDS models was 'Year.' Yellow warbler (*Setophaga petechia*) had the greatest density with 4.45/ha (95% CI: 4.31 - 4.59), followed by Spotted Towhee (*Pipilo maculatus*) with 1.64/ha (95% CI: 1.57 - 1.71) and Warbling Vireo (*Vireo gilvus*) with 1.64/ha (95% CI: 1.58 - 1.70). Although there were annual fluctuations in density, linear trend analyses indicated only 4 species had a significant decline ($P < 0.1$); whereas 9 species appeared to have an increasing trend since 1992. Species with declining trends were Black-billed Magpie (*Pica hudsonia*), American Goldfinch (*Spinus tristis*), American Robin (*Turdus migratorius*), and House Wren (*Troglodytes aedon*). These trends were consistent with Breeding Bird Survey trends for Utah during the same time period. At-risk species Southwestern Willow Flycatcher (*Empidonax traillii extimus*) and Western Yellow-billed Cuckoo (*Coccyzus americanus*) did not have enough observations to obtain density estimates or trends. It is encouraging that riparian bird populations in Utah are not declining at alarming rates, as was expected. Nonetheless, protecting and restoring riparian systems remains important for keeping population trends steady in the face of drought, fire, exotic species, and human activity, which may be exacerbated by climate change.

EFFECTS OF LANDSCAPE-SCALE ENVIRONMENTAL VARIATION ON GREATER SAGE-GROUSE CHICK SURVIVAL

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Conservation planning for a species must be guided by information about population vital rates at multiple scales. Greater sage-grouse (*Centrocercus urophasianus*) require large landscapes of sagebrush (*Artemisia* sp.) to meet their seasonal habitat needs. The environmental factors influencing sage-grouse vital rates, especially at various scales, are relatively unknown. Research has shown that sage-grouse are particularly sensitive to hen and chick survival rates. While hen survival rates have been well studied, chick survival information has been limited to date, and currently there is no reported data considering factors affecting this vital rate across large spatial and temporal scales. We analyzed sage-grouse chick survival rates calculated from radio-marked chicks (~1-day old) in 2 geographically distinct populations (Idaho and Utah) over a 9-year period (1999-2001 and 2005-2009, respectively). We evaluated landscape-scale effects of climate, drought, and vegetation greenness (NDVI). Models with NDVI performed poorly, possibly due to sagebrush canopy masking forb and grass production. The top drought model resulted in a substantial increase in model fit, indicating chick survival was negatively associated with winter drought. Our overall top model included effects of chick age, hen age, minimum May temperature, and precipitation in July. Survival increased with chick age, yearling hens, and minimum May temperature, and decreased with increased July precipitation. Our results provide important insights into possible effects of climate variability on sage-grouse recruitment.

DIFFERENCES IN SURVIVAL AND MOVEMENT OF TRANSLOCATED AND RESIDENT MULE DEER IN CENTRAL UTAH.

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Translocation of wildlife has become common practice for wildlife managers charged with management of animals on increasingly modified landscapes. Goals of translocation projects include reducing population density (to limit habitat damage or disease risk in the source area), supplementing existing populations, reestablishing populations, and introducing populations. Since the 19th century, translocations of ungulates have occurred around the world with varying results. Mule deer (*Odocoileus hemionus*) are an important species in western North America and have been translocated several times. However, very little has been documented about the success of these translocations. Our objective was to determine if translocation is a suitable management tool for mule deer by comparing differences between survival and movement of translocated deer and resident deer. To accomplish this, during January and March of 2013 we captured and translocated a total of 102 deer from winter range near Parowan in southern Utah to winter range near Holden in central Utah (approximately 145 kilometers). We fitted each deer with a radio transmitter (102 total: 18 GPS collars, 84 VHF collars) prior to release. As a control group, we also captured 50 resident deer (9 GPS collars, 41 VHF collars) during the same time period. We monitored radio-marked deer from each of these 3 groups for 1 year and evaluated movements and survival in relation to timing of release, age

of deer, and condition of deer at time of capture. We found no difference in survival between January and March transplants. Translocated deer, however, moved more and survived at a lower rate (~50% annual survival compared to 85% annual survival) than resident deer. Despite increased movements during the summer, however, most of the transplanted deer returned to winter range where they were released during their second winter. Translocation may be a way to establish use of underutilized winter ranges.

IDENTIFICATION OF DIET SUPPLEMENTS FOR ELK MANAGEMENT

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In the Intermountain West elk often occur in great numbers and forage in overused areas potentially threatening other wildlife such as deer (*Odocoileus hemionus*) and Sage-Grouse (*Centrocercus urophasianus*). One major resource issue in Utah is that many shrub communities are in late successional plant community stages, dominated by mature even-aged shrubs with little recruitment of young shrubs. Yet, young, vigorous, shrub-dominated communities are essential for wildlife habitat. We are therefore proposing to use elk as a tool to convert late successional plant communities into vigorous communities. When elk diets are supplemented with food high in protein or energy they can consume old, decadent sagebrush while still receiving sufficient nutrition. We will identify a supplement that can be used to encourage elk to forage in unproductive sagebrush areas. This will stimulate production and release small sagebrush from competition, thus improving habitat for mule deer and sage-grouse. Our approach is in contrast to when elk are fed a complete diet replacement and they no longer need to move around the landscape to seek additional forage. This approach can lead to overuse and degradation of feeding area. Although diet supplementation is a well-established tool for managing livestock distributions, it has not yet been used for wild ungulates such as elk. The first step in this process is to identify which supplements and feeders (that dispense the supplement) are most likely to attract elk. I am proposing to compare the effectiveness of different feeders and supplements at attracting elk at Hardware Ranch, Cache County, Utah.

DETERMINING THE STATUS AND TREND FOR DESERT BIGHORN SHEEP

IN THE NORTH SAN RAFAEL SWELL

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The North San Rafael (NSR) desert bighorn population has been steadily declining for several years. In 2001, the Utah Division of Wildlife Resources counted 326 animals, but only 150 animals in 2008. On average, annual population growth has been $\lambda = 0.89$ since 2001. In January 2012, thirty ewes and 8 rams were captured, tested for disease and fitted with GPS/VHF collars, which were worn for 2 years. During that time the sheep were under constant monitoring. Study objectives were to 1) locate collared females weekly to document survival, 2) locate and necropsy dead bighorns to determine causes of death and limiting factors, and 3) quantify production and survival of neonates. Initial observations after 2 years show that lambing dates ranged from 31 April to 9 June, with a mean date of 23 May. Lamb to ewe ratios were 45:100 in November 2012 and 35:100 in November 2013. Ten mortalities were documented in 2012. In

January 2013 additional sheep were captured/collared to bring totals once again to 30 ewes and 8 rams. An additional ten mortalities were documented in 2013. Of twenty mortalities, 10 were associated with cougar predation, 2 bluetongue, 1 hunter harvest, 2 were linked to reproductive complications (ruptured uterus, dystocia), 1 capture related mortality, and 4 mortalities have unknown causes (not predation). While bronchopneumonia was not identified as a primary cause of death in any bighorn mortalities, it was subsequently developed from secondary infections in 4 of the bighorns before they died. Results of disease testing show that strains of *Mannheimia hemolytica* and *Mycoplasma ovipneumonia* are present in the population and are cause for concern. We estimate that the current population is ~130 animals and is holding relatively constant.

ESTIMATING POPULATION SIZE OF ROCKY MOUNTAIN BIGHORN SHEEP: A COMPARISON OF MULTIPLE MARK-RESIGHT METHODS

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Population size of Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) is traditionally estimated through surveys conducted from helicopters. These surveys, however, can be expensive, prone to high inter-count variation, and may have detrimental effects on the health of bighorn sheep. As technological equipment becomes less expensive, exploring alternative methods of estimating population size of bighorn sheep is warranted. We estimated the number bighorn sheep on Antelope Island State Park in northern Utah, USA, based on observations of individually marked females ($n = 26$) from surveys conducted from helicopters, resight surveys conducted on the ground, and by using remote cameras placed at natural water sources. In 2012 and 2013, we performed 5 helicopter surveys, 40 resight surveys from the ground, and used remote cameras to monitor 14 water sources used by bighorn. Using observations from helicopter surveys we estimated 188 (± 14.78 S.E.) bighorn in 2012 and 151 (± 15.40 S.E.) bighorn in 2013. Using observations from resight surveys conducted on the ground we estimated 150 (± 8.74 S.E.) bighorn in 2012 and 155 (± 10.04 S.E.) bighorn in 2013. Using images captured by remote cameras we estimated 172 (± 9.08 S.E.) bighorn in 2012. We plan to further develop our novel method to determine if remote cameras can be used as an effective tool to estimate the size of populations of Rocky Mountain bighorn sheep in an accurate, inexpensive, and non-intrusive manner. The final results of this study will provide insights into the potential uses of remote cameras as a tool for managers of wildlife.

EFFECTS OF WATER QUALITY ON FISH SPECIES IN CUTLER RESERVOIR

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Pollution and decreased water quality can affect fishes by impacting habitat, food sources, and dissolved oxygen levels, which in turn impact their growth potential and reproductive abilities. Cutler Reservoir, a warm-water fishery located in northern Utah, was listed as water quality impaired under the Clean Water Act in 2010 due to excess phosphorus and periods of low dissolved oxygen levels. Despite this listing, surveys conducted in 2005 and 2006 revealed 14 species of fish residing in the reservoir. This community is comprised of game and non-game fish species, including trophy-sized walleye. With this research I aimed to determine why there is such a wide diversity of fish species thriving in the reservoir, when the reservoir itself is listed as water quality impaired. I examined the Cutler Reservoir TMDL, journal articles focused on the bioenergetics of the fishes in the reservoir, and journal articles focused on nutrient impacts on fish growth in similar bodies of water around the world. Cutler exceeds the limit of 0.025 mg/L for phosphorus (dissolved and total) in all parts, water temperatures exceed 27 °C in the summer months, and the reservoir has a Secchi depth of 0.5 m, indicating high turbidity and poor water quality. A combination of factors seems to contribute to the success of the fishes living in the reservoir. Most of the fish species are tolerant of the warm temperatures in the reservoir because they are warm-water species. In addition, many species possess adaptations to living in turbid environments like Cutler. The low dissolved oxygen levels apparently do not have a drastic effect on the fish species, and the fishes are not limited by food in such a productive environment. Further research may be necessary to confirm these results, and this information could potentially have an impact on the management of the reservoir.

DO SUBORDINATE CARNIVORES ALTER TEMPORAL AND SPATIAL ACTIVITY TO REDUCE COMPETITION WITH DOMINANT CARNIVORES AT WATER SOURCES?

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Smaller carnivores generally assume a subordinate role and partition resources to reduce competition with larger, dominant carnivores. Partitioning of food and habitat resources is common, but there is little information regarding partitioning access to water in arid systems. Water is a spatially and temporally constraining resource in arid landscapes and increased demand during warmer times of the year may lead to increased competitive interactions among carnivores. Our objective was to test the hypothesis that temporal and spatial activity of potentially subordinate carnivores (American badger (*Taxidea taxus*), gray fox (*Urocyon cinereoargenteus*), and kit fox (*Vulpes macrotis*)) are negatively correlated with those of dominant carnivores (coyote (*Canis latrans*) and bobcat (*Lynx rufus*)). During June to September of 2010-12 we used infrared cameras to monitor carnivore activity at 106 water sources in the Great Basin and Mojave Deserts of Utah. We evaluated spatial and temporal partitioning using mixed effects models and

AIC model selection. In total, we recorded 4,676 visits of carnivore species in 9,514 camera days. We found that subordinate carnivores did not spatially partition water sources based on activity levels of dominant carnivores; rather, our top models indicated that subordinate carnivores selected water sources characterized by habitat and physiographic features. We did not detect any temporal shifts in visitation by subordinate carnivores in response to increased activity of dominant carnivores. Our findings indicate that activity of dominant carnivores at anthropogenic water sources does not negatively influence the temporal or spatial use of water sources by subordinate carnivores.

SHORT-TERM DIRECT AND INDIRECT EFFECTS OF FIRE ON DESERT SMALL MAMMALS

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Small mammals are important seed predators and dispersers and can serve as keystone species in North American desert ecosystems. Fire is becoming a more frequent and more widespread disturbance in these deserts as highly flammable invasive grasses expand their range throughout this region. While the abundance and diversity of small mammal communities in burned and unburned desert landscapes can differ for years following a burn, it is unknown to what extent direct and indirect effects of fire are responsible. We assessed the small mammal community via live trapping months and weeks before and after a controlled burn was executed on experimental plots in the Great Basin and Mojave Deserts. We found no indications of a direct effect of fire on small mammal survival in the Great Basin and only one species, Merriam's kangaroo rat, may have experienced decreased survival due to fire in the Mojave. The only species specific or overall abundance measure to decrease on burned plots relative to unburned plots up to a year after fire was for deer mice in the Great Basin, this species appeared to avoid utilizing the burned region three weeks after the fire although no difference was detected from six months to a year after fire. No abundance differences between burned and unburned plots were detected in the Mojave. The direct and short-term indirect effects of fire on small mammals on these plots appear to be minimal and species specific.

COMPETITION AMONG DESERT BATS AT WATER SOURCES: INFLUENCE OF SURFACE AREA AND HABITAT COMPLEXITY

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In arid environments competition for water can shape communities. Small desert bats are particularly vulnerable to water loss and are thus highly reliant on water. However, there is limited information regarding competition for water among desert bats. Two alternate hypotheses exist that likely influence competition for bats at water: surface area (SA) of the water source and habitat complexity (HC)

surrounding water sources. Our objectives were to evaluate 1) support for the SA and HC hypotheses and 2) competition by experimentally manipulating SA. During May to Aug 2010-11, we randomly sampled water sources ($N = 60$) with acoustic detectors in the Great Basin and Mojave Deserts of Utah. Additionally, for our SA experiment, we employed a crossover design with two water tanks and used acoustic detectors and infrared video to record changes in species activity and drinking behavior while we manipulated available SA. We used generalized linear regression to model activity, richness, and diversity from our random samples and competed the two hypotheses using AIC model selection. Richness and activity were primarily explained by SA, whereas diversity was best explained by HC. Our experiment revealed that bats exhibited fewer successful drinking passes with reduced SA. Furthermore, our experiment demonstrated evidence of temporal partitioning between the most abundant species (*Pipistrellus hesperus*) and all other species. Our findings support the hypothesis that SA is associated with activity and richness, but also that HC influences communities. In addition, these data support the idea that the competitive influence of a dominant species can drive local diversity. Based on this study, we recommend maintaining adequate surface area of water sources used by bats in arid environments.

SYLVATIC PLAGUE VACCINE: A NEW TOOL FOR CONSERVATION OF THREATENED AND ENDANGERED SPECIES?

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Plague, a disease caused by the bacterium *Yersinia pestis* introduced into North America about 100 years ago, is devastating to prairie dogs (specifically the threatened Utah prairie dog) and the highly endangered black-footed ferret. Current attempts to control plague in these species have historically relied on insecticidal dusting of prairie dog burrows to kill the fleas that spread the disease. Although successful in curtailing outbreaks in most instances, this method of plague control has significant limitations. Alternative approaches to plague management are being tested including vaccination. A virally vectored oral vaccine to prevent plague in wild prairie dogs has been developed and is being tested as an alternative, preemptive management tool. If demonstrated to be successful, oral vaccination of selected prairie dog populations could decrease the occurrence of plague epizootics in key locations, thereby reducing the source of bacteria while avoiding the indiscriminate environmental effects of dusting. An integrated plague management strategy could be enhanced with the addition of a cost-effective, bait-delivered, sylvatic plague vaccine (SPV) for prairie dogs. Control of plague in prairie dogs, and potentially other rodents, would significantly advance prairie dog conservation and black-footed ferret recovery. The sylvatic plague vaccine efficacy trials commenced in 2013 with 30 study sites in 8 states across all 4 prairie dogs species in the United States with the potential for 2 sites in Mexico. Utah currently has 7 study sites for Utah prairie dogs and 2 study sites for White-tailed prairie dogs overlapping with the Black-footed ferret Recovery Area. Field trials will continue for a total of three years followed by an adaptive management phase to refine use of SPV as a management tool.

PEREGRINE FALCONS AS IDEAL MERCURY BIOMONITORS

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Human-caused mercury deposition is a significant concern for human and wildlife health in Utah watersheds and beyond. Mercury levels in the Great Salt Lake (GSL) are among the highest recorded in a North American aquatic system, yet little research has been done on the potential ecological impacts this contamination may have on the millions of migratory and breeding birds relying on the GSL ecosystem. Avian exposure to mercury can impact the nervous, circulatory, and endocrines systems and has been linked to increased mortality and reduced reproductive success. Peregrine falcons (*Falco peregrinus*) may serve as ideal "biomonitors" of mercury contamination in the environment based on their widespread global distribution, use of diverse habitats, nest site fidelity, longevity, and broad dietary breadth. For example, 94 avian species were successfully sampled at falcon eyries during similar work conducted in Nevada by the lead author. During a pilot effort this spring (2014), we plan to collect feather samples from falcons and avian prey items at 6–12 nests near the GSL. In addition, we and our partners will collect samples from other GSL-area raptors captured at the Salt Lake International Airport, submitted for rehabilitation, and encountered during local banding operations of golden eagles (*Aquila chrysaetos*) and American kestrels (*Falco sparverius*). Mercury levels in samples will be determined in the lab through thermal decomposition. We hope this initial effort will serve to demonstrate the feasibility of using Peregrine Falcons to monitor mercury levels in the GSL environment and associated avian species and generate interest amongst potential partners in expanding the monitoring program to a larger geography in future years.

INFLUENCE OF TRANSLOCATION ON GREATER SAGE-GROUSE IN STRAWBERRY VALLEY, UTAH: HAS GENETIC DIVERSITY INCREASED FOLLOWING AUGMENTATION?

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Conserving genetic diversity is a priority for wildlife managers because low diversity is correlated with low fitness. Translocations have been used as a strategy to increase both population size and genetic diversity in wildlife populations. In central Utah, the Strawberry Valley population of greater sage-grouse (*Centrocercus urophasianus*) experienced one of the most severe declines reported for this species with estimates of abundance in 1998 of less than 5% (~150 individuals) of similar estimates from the 1930s (> 3,000 individuals). Genetic analysis of microsatellite and mitochondrial DNA indicated that this population experienced a large decline in genetic diversity and had low genetic diversity compared to sage-grouse from other areas. Given the population decline and reduced genetic diversity, recovery team partners translocated sage-grouse from four different populations into Strawberry Valley over 6 years (2003-2008). We assessed whether genetic diversity increased following the translocation of sage-grouse into Strawberry Valley by looking at both nuclear and mitochondrial DNA indices. We observed an overall increase of 16 alleles across the 15 loci studied (\bar{x} = 1.04 alleles per locus increase, SE \pm 0.25). Haplotype diversity increased from 4 to 5. Haplotype frequencies also changed suggesting that some independent maternal lines were successfully introduced. Levels of genetic diversity increased for both nuclear and mitochondrial DNA (16% and 25% increases for allelic richness and haplotype diversity, respectively). Translocations of greater sage grouse into a wild population can be an effective tool to increase not only population size but

also genetic diversity. These results provide further evidence that augmentation of wildlife populations with new individuals can be an effective tool to increase genetic diversity.

USING SYNTHETIC APERTURE RADAR FOR DETECTION OF POLAR BEAR DENS

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Synthetic Aperture Radar or SAR is a tool that is used in order to detect disruptions in environments that are otherwise primarily uniform. While SAR is a tool that has commonly been used in military and industrial applications, we are only now looking at its potential benefits for wildlife research. A denning female polar bear represents a medium that contrasts sharply with the ice and snow environment it is found in, and it is our belief that it will be easily discernable with the use of modern MicroSAR technology. Current polar bear research relies on a number of methods for detecting denning polar bears, and the efficacy of these methods are highly dependent on favorable weather and a number of other potential variables. SAR technology is much less hampered by these kinds of obstacles, and our research aims to prove that SAR can be an effective and important tool for polar bear den detection. We will work with a local SAR company, IMSAR, who specializes in aerial SAR technology. We will use their MicroSAR units to survey roughly 100km of coastline on Alaska's North Slope. Following these survey flights, researchers and SAR technicians will analyze the SAR imagery in order to identify known (GPS verified) and unknown polar bear dens. It is our hope that a denning polar bear will show up in the SAR imagery as a strong shadow.

MOUNTAIN LION (*PUMA CONCOLOR*) HOME-RANGE SIZE AND THE NORMALIZED DIFFERENCE VEGETATION INDEX: USING A LANDSCAPE PRODUCTIVITY INDEX AS A SURROGATE FOR PREY DENSITY

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Mountain lions (*Puma concolor*) are an obligate carnivore widely distributed across the Colorado Plateau. Management of this species is focused on population-level manipulations, due to their mixed economic status as a valued game species and as a factor influencing prey populations, livestock production, and human safety. However, the ability to manage a cryptic, low-density species is predicated on an understanding of the spatial requirements necessary to meet its nutritional demands and how this parameter

varies across heterogeneous landscapes. Mountain lion spatial requirements vary primarily as a function of prey density, which is driven by primary productivity. Our objective was to evaluate the relationship between mountain lion home range size and indices of primary productivity. We obtained radio-telemetry data for 54 males and 101 females from study sites in Utah, Arizona, and Nevada. These animals occupied uplands across the Colorado Plateau, Great Basin, and Mojave Desert ecoregions. We used the normalized difference vegetation index (NDVI) to estimate environmental productivity at 500 m resolution. These data were derived from imagery collected by the moderate-resolution imaging spectroradiometer (MODIS). We calculated time-specific, mean monthly growing-season NDVI values for the annual home range of each individual animal. We found a negative relationship between NDVI and mountain lion space-use, with Mojave Desert females encompassing home ranges greater than an order of magnitude larger than the smallest female home ranges (700 vs. 30 km²). These results agree with other findings demonstrating that carnivores require less space to meet their nutritional demands as environmental productivity increases. Moreover, our results provide evidence that NDVI - a readily available data source - can be used to estimate ecological relationships across three trophic levels. In the absence of requisite field data, these relationships can help inform mountain lion population models across the range of habitats they occupy in the greater Southwest.

ANALYSIS OF MEXICAN SPOTTED OWL DIET IN THE CANYONLANDS OF SOUTHERN UTAH

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While diets of Mexican Spotted Owls (*Strix occidentalis lucida*) within forested habitat have been studied, little research has been published on the diet of owls that occupy canyon habitats ([see Willey In Press](#)). We analyzed the contents of Mexican Spotted Owl pellets collected in the canyonlands of southern Utah from 2011-2012 to determine diet composition. A complete list of prey species was compiled and the mean dietary composition was computed for each owl territory. Mean biomass and frequency of prey captured at each site was also calculated. We identified 358 prey items from 8 known Mexican Spotted Owl nest/roost sites. More than half of the diet was comprised of arthropods (55.03%), followed by mammalian species (50.28%). A small percentage consisted of, reptile species (1.4%) and avian species (1%). Mammals contributed 99% of total prey biomass, of which 88% were woodrats (*Neotoma spp.*) and 5% deermice (*Peromyscus spp.*). Arthropods (0.002%), avian spp. (0.004%), and reptile spp. (0.003%) contributed less than 1% of total prey biomass. We compared prey composition to past data collected in canyonlands to determine if prey composition is consistent over time. We determined that there is no significant difference between our data compared to past data. The majority of prey type captured were classified as nocturnal species suggesting that these owls primarily forage at night. We hope that the findings from this research can better inform state and federal managers on the ecology of canyon dwelling Mexican Spotted Owls. Understanding Mexican Spotted Owl diet in canyon habitats will provide insight into potential population limiting factors.

AN ANALYSIS OF BLACK BEAR (*URSUS AMERICANUS*) – HUMAN CONFLICT IN UTAH

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Conflicts between humans and carnivores are common where ever both species exist. A better understanding of where, when, and why these conflicts occur will lead to fewer of them, as well as the conservation of the carnivore involved. Interactions between black bears (*Ursus americanus*) and humans have occurred throughout the history of Utah. We collected records of these interactions from the Utah Division of Wildlife Resources and National Park Service. We also used Google™ to find records in the news and online. We created a database of these records in Microsoft Access®. Records were classified as sighting, encounter, incident, attack, property damage, or vehicle collision. We plotted each record in ArcGIS® in order to explore spatial relationships. We also analyzed data to look for correlations between interactions and independent variables. Results will contribute to the UDWR's bear safety information which will promote greater safety in bear country.

GREATER SAGE-GROUSE CHICK SURVIVAL USING LUKACS' MODEL IN PROGRAM MARK

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The Greater Sage-Grouse population in Strawberry Valley, Utah (SV) has experienced a precipitous decline (> 97%) since the 1930s. In an attempt to curtail this decline, > 300 female grouse were translocated to SV over a 6 year period (2003-2008). This effort was intended to increase genetic diversity and augment population size which should influence population growth (λ). Chick survival for Greater Sage-Grouse is one of the most influential vital rates that affects population growth. In order to determine if chick survival improved during and post-translocation, we estimated chick survival before, during, and after the translocation period (15 years total). We employed a two-step model selection approach (AIC_c) and Lukacs' model of young survival from marked adults in program MARK to evaluate variables that may influence chick survival to 49-days post-hatch. Chick survival ($\pm SE$) prior to the translocation was 0.15 ± 0.06 . During and post-translocation chick survival was 0.41 ± 0.03 , and 0.23 ± 0.05 respectively. Three variables in the top models ($\Delta AIC_c < 2.0$) that may have influenced chick survival were precipitation, temperature, and hatch date. Time trends (either linear or modified quadratic) always improved model fit, with chick survival increasing over time. Increased brood density and continued predator control are two explanatory variables that were not tested in our models but may have influenced chick survival during and after translocation years. These data will be used in a life table response experiment (LTRE) to evaluate the influence of different vital rates on λ in Strawberry Valley, Utah.

ANALYSIS OF MORPHOMETRIC CHARACTERISTICS FOR SEX DETERMINATION OF THE EURASIAN COLLARED-DOVE IN THE FIELD.

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The Eurasian Collared-Dove (*Streptopelia dacocto*) is a species of Columbidae recently introduced to North America. Since its introduction to New Providence, Bahamas, in the mid-1970s it has rapidly dispersed throughout the continent and is abundant in much of its range. This introduction may be cause for concern for native species in North America, particularly the Mourning Dove. But, the extent of the effect the introduction of Collared-Doves has had on the ecology of native species is not fully understood. No current method of determining the sex of individuals in the field, due to strongly similar morphology of males and females, is known to be efficacious for Eurasian Collared-Doves. Knowing the sex of individuals is important when asking questions regarding the demography of a population, and so, this basic question must be answered before further understanding can be made about Collared-Dove ecology. This project's efforts are focused on providing a method, if any can be found, to determine sex of individual Eurasian Collared-Doves in the field. Methods are being explored through measuring multiple features of captured birds whose sex will be confirmed through genetic analysis of blood samples. Measured features include several body measurements of each bird and plumage characteristics. These variables are then used to create morphometric models for predicting gender.

PORTABLE ELECTRIC FENCING FOR BEAR DETERRENCE AND CONSERVATION

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Although bear-inflicted fatalities are rare in North America, many injuries, property damage, and bear deaths occur annually wherever bears and humans commingle. While our behavior is crucial for reducing the risk of bear-human conflict, it is not possible to eliminate all risk. Technological advances in recent years, however, now provide new tools for bear deterrence. Chief among these is portable electric fencing, a heretofore underutilized deterrent option. Our interaction with the public, resource managers, recreationists, and bear biologists has convinced us that this largely underused deterrent will promote bear conservation while protecting humans from bear-inflicted injuries. The purpose of this paper is to encourage more widespread use of electric fencing in bear country for protection of people, their gear, and to promote bear conservation. We present data from 30 years of extensive use of electric fencing across North America. We also present an analysis of soil conditions which affect the efficacy of electric fencing and offer suggestions for optimal usage.

FROGGER, GAME OVER: ROADS REDUCE FROGS ACROSS THE EASTERN US

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Land use has a profound effect on frogs; roads, in particular, may be deleterious to their populations. In 2013 a network of undergraduate classes studied the effects of small-scale (<1 km) landscape features on frog distribution and richness across 15 states in the eastern and central U.S. Frog call data was analyzed from 1600 locations using North American Amphibian Monitoring Program (NAAMP) data, a citizen-science generated database, and landscape features, including traffic volume, road length, development, forest cover, agricultural cover, and wetland area, were collected using GIS software. The 2013 study suggested that high road density and traffic volume negatively affected frog presence and richness, low to moderate levels of development positively affected richness, and that wetland area positively affected richness. The use of a single scale in the 2013 study limits its usefulness because it does not capture potential metapopulation dynamics nor does it allow us to make specific management recommendations about potential buffer sizes needed around wetlands. Analyzing the same factors across multiple scales provides a greater understanding of how landscape features affect frog populations. We analyzed data from NAAMP routes and collected landscape data in the state of Missouri and made synonymous models to those done in 2013 across five scales, from 300 m up to 10 km. Using similar models, we will be able to determine how landscape features affect frog presence and richness at different scales. In addition, by incorporating measures of connectivity of wetlands, we will be able to determine the importance of landscape feature arrangement. Finally, data analysis will allow us to determine whether the isolating effects of roads or road mortality reduce frogs near high road density and whether different road types have different limiting effects on frog distributions. Results will have implications for road and developmental planning near wetlands.

IMPACT OF COHORT SIZE, REARING TYPE, AND WATER AVAILABILITY ON THE SITE FIDELITY AND SURVIVAL OF TRANSLOCATED CHUKARS

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Translocation is an artificial surrogate for dispersal and colonization of wildlife, and is commonly used in conservation and management of many species. Successful translocations of upland game birds have been reported in the literature. Nonetheless, determining the success of most translocations is difficult because of logistical constraints with monitoring released individuals after relocation. Chukars (*Alectoris chukar*) are medium-sized game birds that have been widely introduced for hunting purposes, but little is known regarding survival and site fidelity of translocated individuals after release. We evaluated a program that releases pen-reared chukars to enhance wild populations. In addition to releasing and monitoring pen-reared birds, we released and monitored wild-trapped individuals to assess differences in survival and site fidelity. We also analyzed the effects of water availability at release sites and number of individuals in relocated groups to determine the influence of these factors on successful chukar relocations. Although this study is a work in progress, data collection is largely complete. Preliminary results indicate that wild-translocated cohorts survived better, but dispersed more than pen-reared birds. However, pen-reared

individuals that mixed with wild chukars had improved survival. The importance of group size and water availability on survival and site fidelity was site and age-specific. Both adult and hatch-year chukars at some sites showed strong positive responses in survival and site fidelity to available water; whereas we only observed similar results in hatch-year birds at certain other sites. Similarly, we recorded generally lower survival for small groups. Understanding proper techniques for successful chukar relocations will provide essential information for producing suitable management strategies to maintain populations and concomitant hunting opportunities.

IDENTIFYING MATERNAL DENNING BEHAVIOR IN POLAR BEARS USING TEMPERATURE

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Substantial changes in the Arctic environment have the potential to negatively impact polar bear populations. Cub survival and reproduction have been documented to be one of the first demographic features affected by sea ice loss in polar bear populations and therefore are important in population monitoring. However, maternal denning of polar bears, which is a critical component to reproduction and cub survival, has traditionally been difficult to monitor. Here we develop a tool to improve remote tracking of denning polar bears using temperature data collected on-board Argos satellite collars. Polar bears using maternal dens experience a prolonged increase in temperature during the winter denning period compared to non-denning individuals. We used statistical process control methods to identify these warmer temperature regimes. We used a subset of temperature records that were previously classified as denning or non-denning by Fischbach et al. 2007 to generate parameters for process control charts. Bear-winters with >35 days above upper control limits were classified as denning while those with <35 days were considered non-denning. Of 622 bear-winters our algorithm classified 242 as denning, and 380 as non-denning. We compared our results to subjective denning classifications made by Fischbach et al. 2007 which included bears from the same data set. Our algorithm agreed with the Fischbach et al. 2007 classifications 97% of the time, after removing individual records with insufficient data. As part of our continuing analysis, we will ground truth our classifications using data from individuals confirmed to have denned, either via direct observation during the denning period or during the following spring based on reproductive status. Additionally, we will estimate den entry and emergence for all individuals, and compare these estimates to direct observations. This technique will be used to analyze the denning phenology of polar bears in the Chukchi and Southern Beaufort Sea over the past 30 years.

OBSERVATIONS ON A SPRING DOWNING OF EARED GREBES AT DUGWAY PROVING GROUND, UTAH

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Eared grebes (*Podiceps nigricollis*) regularly experience mass downing events. Migration routes are particularly hazardous for eared grebes that utilize Great Salt Lake, Utah. Downing events have been reported in this area for decades, though most occur in the fall when birds are migrating south. On 15 April 2013, approximately 13,500 eared grebes crash landed in and around Dugway Proving Ground in western Utah in association with an unseasonably late snowstorm. Biologists from several state and federal agencies responded quickly to capture and release surviving grebes. Monitoring of released grebes on local water bodies and examination of carcasses from birds killed on impact or following release provided opportunity to further understand migration ecology of this species. Our specific objectives were to examine specimens from this downing event to describe characteristics of the migrating population and provide information on conditions (e.g., weather) that contributed. We examined 173 birds that died on impact and 42 birds that were released and later died in nearby ponds. The sex ratio of our sample was approximately equal (47.1% males, 52.9% females; $P = 0.354$) whereas the age ratio was biased towards adults (86% adult, 14% juvenile; $P < 0.001$). Grebes that died on impact had a higher proportion of neck and sternum injuries than grebes that died later in ponds ($z = 2.463$, $P = 0.014$; $z = 2.631$, $P = 0.009$, respectively). In contrast, grebes that later died in ponds had a higher proportion of leg injuries than grebes that died on impact ($z = 3.127$; $P = 0.002$). Weather was likely the proximate cause of the downing as this event was coupled with heavy snow, thick fog, and strong wind. Downing events cannot be prevented, however managers can be forewarned as specific weather conditions coalesce during migration periods.

UNGULATE REPRODUCTION AND PLANT PHENOLOGY ON THE COLORADO PLATEAU

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Mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and bighorn sheep (*Ovis canadensis*) are three widely distributed ungulates indigenous to the Colorado Plateau. These species can have important direct effects on ecosystems through herbivory, or indirectly by supporting large carnivores. Resource agencies monitor the distribution and abundance of these species because of the economic benefits and costs associated with recreational hunting, tourism, and agricultural damage. Dietary constraints promote variation in habitat selection among ruminants, but climatically driven productivity in high elevation plant communities is thought to set limits on their abundance. Current projections for the region indicate continuing land use change nested within a desiccating climate. Given these stressors, a predictive

understanding of the relationships between ungulate abundance and plant phenology will be important for devising regional conservation strategies. We used long-term datasets collected by the Utah Division of Wildlife Resources and Arizona Game and Fish Department to evaluate demographic responses of mule deer, elk, and bighorn sheep to variation in summer range productivity. We compared the numerical response of each species to the timing and magnitude of plant phenology, as indexed by the Normalized Difference Vegetation Index (NDVI). Using multiple regression and GIS techniques, we modeled the relationship between mean monthly NDVI and indices of abundance for each species. We then created spatially explicit models of potential ungulate densities across the Colorado Plateau. Results suggest a decreasing sensitivity to the timing and abundance of primary productivity corresponding to digestive strategy. Mule deer populations were sensitive to the rate of change in greening (May-June), whereas elk abundance was most strongly correlated with peak green biomass (July-August). Bighorn sheep have the widest dietary tolerance and exhibited the weakest correlation with any measure of NDVI. We discuss the implications of ungulate physiology, interspecific competition, and vulnerability to predation in light of changing climate and land use patterns.

GREATER SAGE-GROUSE RETROSPECTIVE AND PROSPECTIVE POPULATION DYNAMICS ON PARKER MOUNTAIN, UT

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The greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) is currently a species of conservation concern, with potential to be federally listed. Relatively few studies have been published on the population dynamics of this species. No study of a specific population has used long-term telemetry data to build life-cycle models. Parker Mountain, in south-central Utah, has had over 12 years of telemetry based monitoring from 1998-2009. We used survival and reproductive parameters of females to construct both prospective (sensitivity and elasticity) and retrospective (Life Table Response Experiment; LTRE) population models to assess vital rates important to future and past population dynamics. We found that adult female survival has the most potential to influence the population growth rate prospectively; however, cumulatively, reproductive parameters have had the most influence on growth rate in the past. Specifically, the progression of females surviving through life stages beginning at hatch, to juvenile, to yearling (second year) and finally to full maturation (after second year or adult) has provided significant influence on population growth. Based on clutch size and egg viability measures, the number of successful eggs in a clutch may be an important research and management consideration. Our results suggest a focus on individual vital rates alone (e.g., nest survival) may not be appropriate, but understanding how vital rates interact to influence population growth provides a broader context for future management and research. The Parker Mountain population was monitored with standardized lek counts by the Utah Division of Wildlife Resources (UDWR) during our study period. We modeled growth rates from lek counts and compared these to modeled growth rates from telemetry-based life-tables. We found little difference in annual growth rates with a similar pattern of annual change over time, supporting standardized lek counts as a viable way to monitor population change. Overall, the Parker Mountain sage-grouse population was stable throughout our study period.

THE RELATIONSHIP OF BULBOUS BLUEGRASS AND BIG SAGEBRUSH AND THE POTENTIAL IMPLICATIONS FOR SHRUBSTEPPE WILDLIFE IN UTAH

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The increase in abundance and distribution of bulbous bluegrass (*Poa bulbosa*) is a concern; however, little research has been conducted to analyze the invasiveness of bulbous bluegrass in the Intermountain West. This study used data from 1982 to 2012 at Utah Division of Wildlife Resources range trend study sites across the state of Utah to investigate trends in bulbous bluegrass abundance, range expansion, and co-occurrence with big sagebrush (*Artemisia tridentata*) and cheatgrass (*Bromus tectorum*). This study addressed the question of whether the increase of bulbous bluegrass correlates with changes in sagebrush and/or cheatgrass in Utah using a log-response ratio analysis. Our results show a large range expansion of bulbous bluegrass in Utah and an increased abundance of this species in relation to cheatgrass and sagebrush. We will discuss how the invasive nature and increased abundance of bulbous bluegrass within sagebrush rangelands could threaten desirable flora and fauna and suggest further research to more specifically identify these threats and examine which climatic, landscape, and anthropogenic variables are contributing to the bulbous bluegrass invasion.

EXOTIC HERBIVORE INFLUENCES WILDLIFE COMMUNITY USE OF A SCARCE RESOURCE IN A SEMI-ARID ENVIRONMENT

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Where species co-occur and compete for resources, there are typically mechanisms that enable coexistence and enhance community stability. However, the processes that stabilize communities and lead to coexistence typically evolve over long periods of time. The introduction of species that are not native to a system potentially alters competition dynamics (i.e., exotic species) may pose a threat to native species that likely have not had sufficient time to acquire adaptations to partition resources with the newly introduced competitors. Large exotic species, such as the horse (*Equus caballus*), may have a competitive advantage over smaller native species and exclude them from access to limiting resources. Our objective was to determine the influence of a recently introduced exotic herbivore (horse) on the spatial and temporal use of a scarce and spatially restricted resource (water) by native species. From July 2010 to August 2011 we used remote infrared cameras to monitor water sources in the Great Basin Desert of western Utah. We monitored water sources where horses had drinking access and water sources where horses were excluded (with fencing) to compare 1) composition of native communities and 2) temporal patterns of visitation by native species. We captured 101,694 images representing 76 species of vertebrates including 60 species of birds (34,038 images) and 16 species of mammals (67,458 images). Of the 67,458 images of mammals, we obtained 53,228 images of exotic horses. Horses were associated with decreased richness and diversity of native species and an overall shift in community composition. Furthermore, horses were associated with

less frequent and shorter visits by native species. Our results indicate that horses spatially and temporally displaced native species at water sources providing evidence of a negative influence on communities of native wildlife.

**MAMMALIAN SPECIES SEEN AT FEMALE BLACK BEAR DENS:
RANDOM OR NON-RANDOM DEN VISITORS?**

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Using photographs taken by motion-activated cameras placed at the dens of hibernating black bears, Julie Miller has provided insights into nest maintenance, mother-offspring interactions, timing of den exit and departure, and response of bears to handling. Photographs at these dens also reveal that other bears visited these dens, and that other mammalian species (rodents, lagomorphs, felids, servids, mustelids, and canids) also approached the den sites. Some of the visiting bears investigated the occupied dens, while others appeared after the occupants had left. For the carnivores at least, olfaction probably provided direction in finding the dens. Of the 31 dens providing long-term monitoring, 10 were visited by bears. We hypothesize that the smell associated with dens acts as an ecological magnet attracting bears especially to these sites (10 of the 16 carnivores photographed at these dens were bears). From a sample of 191 winter dens (42 different bears), we found that 5 individual adult female bears on the Book Cliffs of Utah reused their own or another bear's den. Based on the relatively high frequency (32%) of visits to dens documented here, we suspect that while a bear may be in a new den for it, the den may have had a previous occupant.

EMERGING RAPTOR MONITORING PROGRAMS AT HAWKWATCH INTERNATIONAL

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HawkWatch International, Inc. (HWI), based in Salt Lake City, Utah, is well-known for fall raptor migration monitoring, but also coordinates other monitoring efforts to track changes in Utah raptor populations and the environment. We introduce three emerging monitoring programs focused on wintering raptors, nest box use by American kestrels (*Falco sparverius*), and mercury contamination in raptors and their prey. Volunteer winter surveys conducted in Utah during the past four winters (2010/11–2013/14) reveal dense concentrations of raptors in rural areas where available perches and agricultural lands intersect. We continue to explore new survey locations while maintaining Snowville, Logan, and Fillmore as high-density reference sites. Understanding factors contributing to distributions will aid our understanding and mitigation of mortality risks associated with concentration areas (i.e., collisions, electrocutions, shooting, disease, etc.). In 2013, HWI adopted or erected 113 nest boxes for kestrels along the Wasatch Front as part of a larger North American box monitoring partnership formed due to concerns over population declines. Up to 50 additional boxes will be erected in 2014 with the goal of achieving fair representation of boxes in four local landscape types of interest. Long-term monitoring of boxes by volunteers and staff will allow us to assess kestrel nesting demography in relation to a gradient of human development. Documented mercury levels in the Great Salt Lake (GSL) and other Utah watersheds is a concern for both human and wildlife

health. Peregrine falcons (*Falco peregrinus*) and other raptors that prey on waterbirds may serve as ideal mercury "biomonitors". In 2014, we will undertake a pilot effort to sample feathers of raptors and prey items in their nests near the GSL to determine the feasibility of expanding the program in future years to assess mercury contamination and potential raptor and human health implications at broader scales.

DEMOGRAPHIC CHARACTERISTICS OF UTAH MOOSE: THE EDGE OF THE RANGE

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Moose in Utah are the southernmost naturally-occurring moose population in North America. However, knowledge of population dynamics of moose in Utah, as well as edge populations of large ungulates in general, is scarce. Consequently, a study is currently underway to estimate the vital rates of Utah's moose herds as well as the more general demographic responses of moose at their southern range limit. In winter 2013, 120 female moose were radiocollared in the Uinta and Wasatch mountains to assess the vital rates in these two moose strongholds in Utah. After a year of continuous monitoring, we report our preliminary results. Ultrasonographic measurements indicate Utah's moose have lower rump fat than other published studies, although this could be due to size differences between different populations. We found a significant positive relationship with rump fat and the probability of pregnancy and this effect was nonlinear, indicating that moose only require a small amount of body fat to achieve pregnancy. Adult pregnancy rates were relatively high (80%) which is comparable to other populations in central moose range, and did not differ between the Wasatch and Uinta herds. Thus, although body fat could be low, moose in Utah do not appear to be suffering from low pregnancy rates. However, we only documented calves with 28% of adult females in the Wasatch, and 54% of adult females in the Uintas during summer. Trace mineral content from blood taken during capture was analyzed and moose were found to be deficient in several elements including selenium, which has been tied to reproductive losses in ungulates. We found a significant positive effect of selenium on the probability that we observed calves with cows in summer. Annual survival rates were ~85% and did not differ between the two study areas. Research and monitoring will continue until at least 2016.