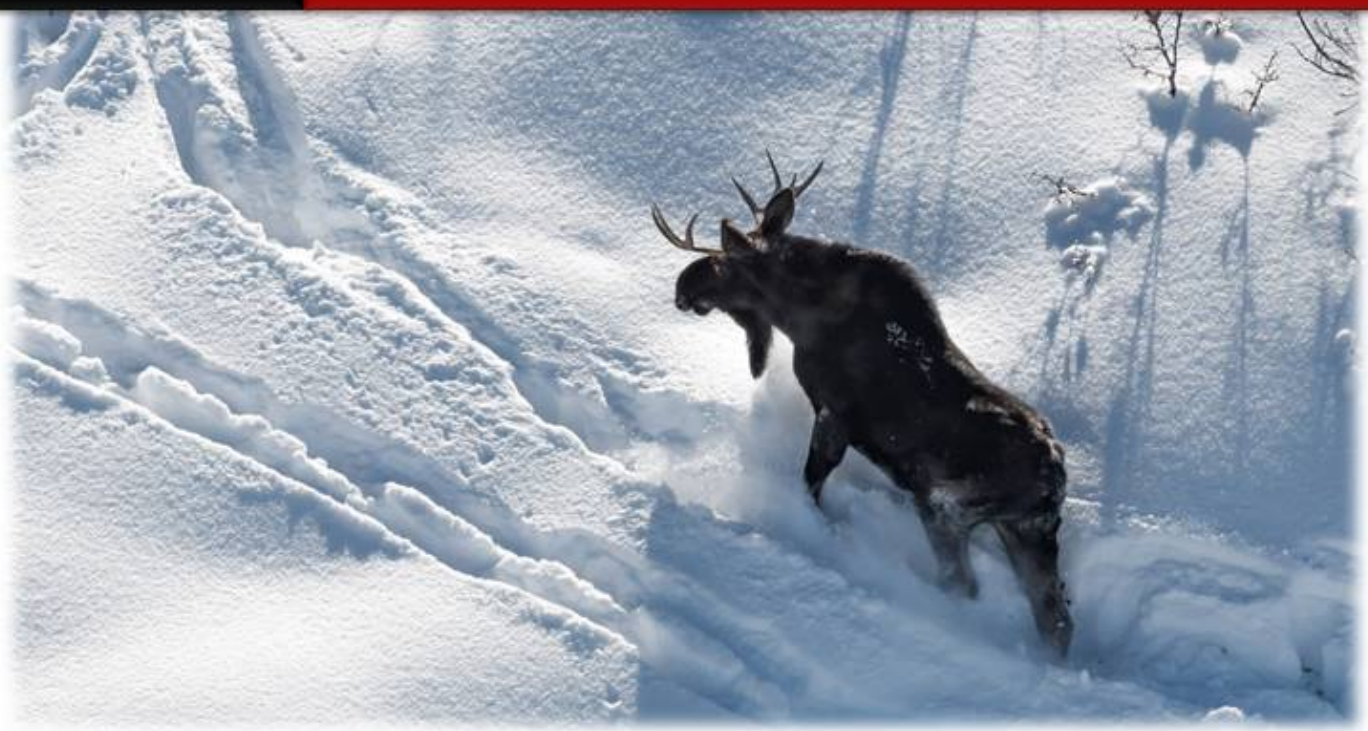
MARCH 21-23, 2018

UTAH CHAPTER OF THE WILDLIFE SOCIETY



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UTAH CHAPTER OF THE WILDLIFE SOCIETY

1965-2018

ANNUAL MEETING

Vernal, Utah

March 21-23, 2018

UTAH CHAPTER BOARD MEMBERS

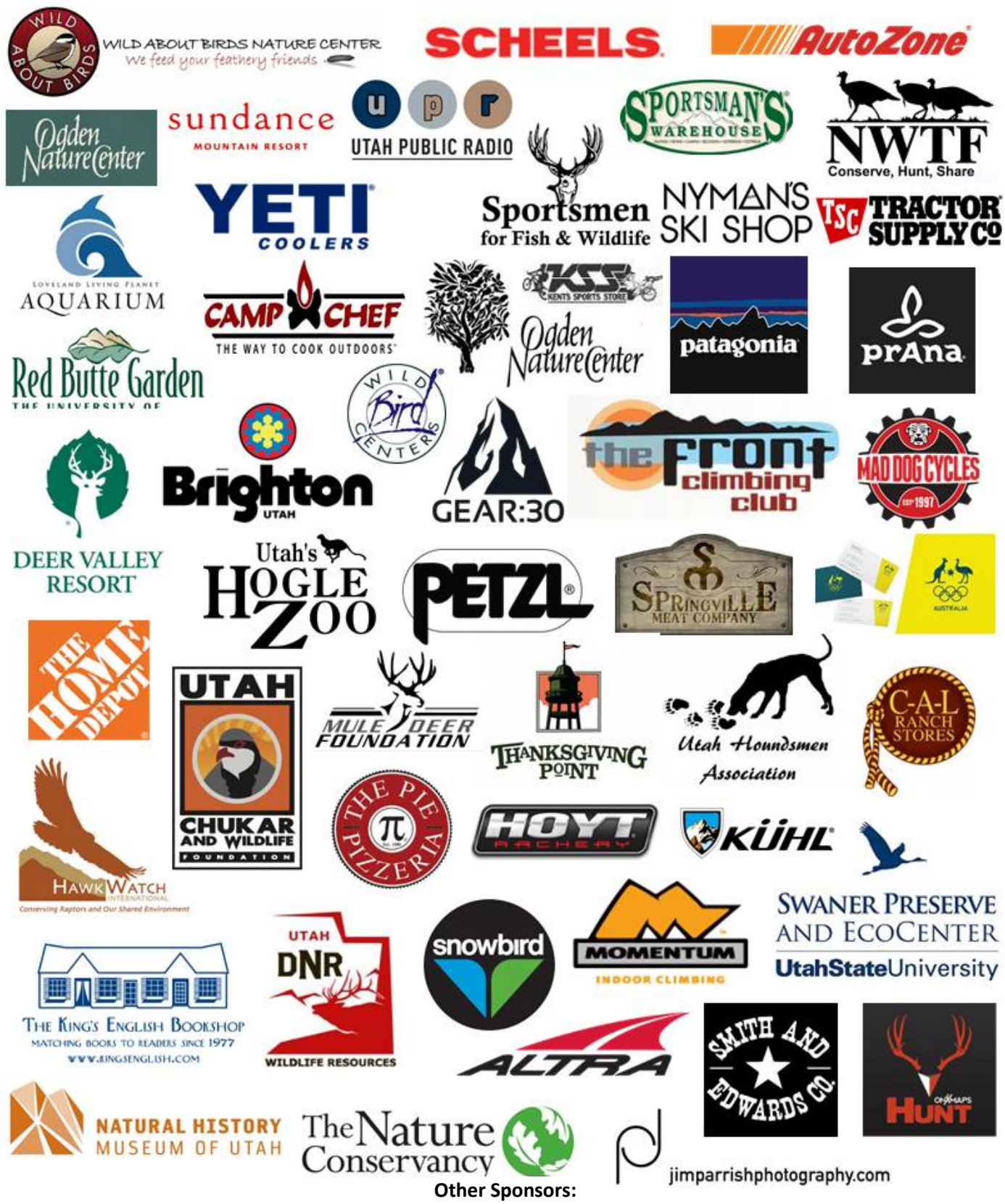
Brock McMillan, Past-President
Riley Peck, President
Stephanie Graham, President-elect
Tonya Kieffer, Secretary
Terri Pope, Treasurer
Keeli Marvel, Odd-Year Member
Masako Wright, Even-Year Member
Robert Edgel, Webmaster

Uintah Conference Center
313 E 200 S
Vernal, UT 84078

Schedule at a Glance

Wednesday, March 21st	
8:00 AM	FIELD TRIPS
11:00 AM	TWS Registration
1:00 PM	Welcome and Plenary Session
2:45 PM	BREAK
3:00 PM	Plenary Session
5:00 PM	Adjourn until evening events
7:00 PM	TWS Social
7:30 PM	Utah TWS Quiz Bowl
Thursday, March 22nd	
7:30 AM	TWS Registration
8:00 AM	Technical Session
10:20 AM	BREAK
10:35 AM	Technical Session
12:05 PM	LUNCH
1:15 PM	Technical Session
3:05 PM	BREAK
3:20 PM	Technical Session
5:00 PM	Adjourn for poster session & evening events
6:30 PM	Awards Banquet – (Uintah Conference Center)
Friday, March 23rd	
7:30 AM	TWS Registration
8:00 AM	Technical Session
10:20 AM	BREAK
10:35 AM	Technical Session
11:55 AM	Meeting Adjourned

THANK YOU to all our 2018 Sponsors!



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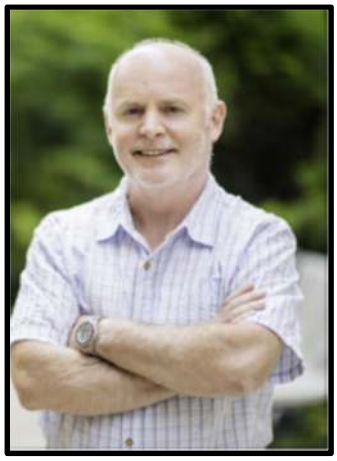
Plenary Session

2018 Theme: Fire and Ice of Wildlife Management-
Life in an Arid Landscape

This year our theme calls to mind two diametric opposites: Fire and Ice. At first glance they may seem like polar opposites, but in the realm of wildlife management they are intimately connected. Because of our arid climate, water resources have always played, and will continue to play, a huge part in the management of wildlife species in the state of Utah. With the introduction of invasive species, rising temperatures, and other factors, fire has also become a huge driver in our fiscal planning and our management strategies. Our speakers this year were chosen with these themes and the point at which they intersect in mind.

ASHLEY KIJOWSKI, Wildlife Biologist, Great Salt Lake Ecosystem Project (GSLEP), Utah

Ashley is a Wildlife Biologist at the Great Salt Lake Ecosystem Program (GSLEP) within the Utah Division of Wildlife Resources (UDWR). There her duties are to develop research questions, prepare study design and conduct research in regards to the Great Salt Lake ecosystem. At GSLEP, they focus on managing the commercial brine shrimp fishery to ensure parity among harvesters and control the harvest to make certain the ecosystem needs are met. Ashley began working at GSLEP in December of 2013. Before moving to Utah, she worked a variety of jobs throughout northern Wisconsin and Illinois with a focus on wetland creation, restoration and monitoring. She earned a BS from Illinois State University in Biology and Environmental Science and an MS from the University of South Dakota in Ecology with a focus on invertebrate community ecology and conservation.



DR. ROBERT R. GILLIES, Professor of Climate in Plants, Soils and Climate, Utah State University; Director – Utah Climate Center; State Climatologist - Utah

Dr. Robert R. Gillies grew up in Scotland. He received his Master's in geography from the University of Glasgow, and studied meteorology at the Pennsylvania State University. He was a research associate at Penn State while working on a PhD in meteorology and remote sensing from the University of Newcastle. Dr. Gillies joined the faculty of Utah State University in 1996 with a joint appointment in the departments of Geography and Earth Resources and Plants, Soils and Biometeorology. In 2006, Dr. Gillies became the director of the Utah Climate Center, where he set a new course for the center by making the center's databases of Utah climate information accessible on-line. Dr. Gillies is an author or co-author of dozens of refereed journal articles and official reports. He has conducted numerous presentations within the State of Utah, as well as at national and international venues in the science behind inversion prediction, climate precipitation cycles (particularly for the Intermountain West) and, global climate change.

DR. CHRISTOPHER (KIT) O'CONNOR, Ecologist, Wildfire Risk Management Group, US Forest Service Rocky Mountain Research Station, Missoula, Montana

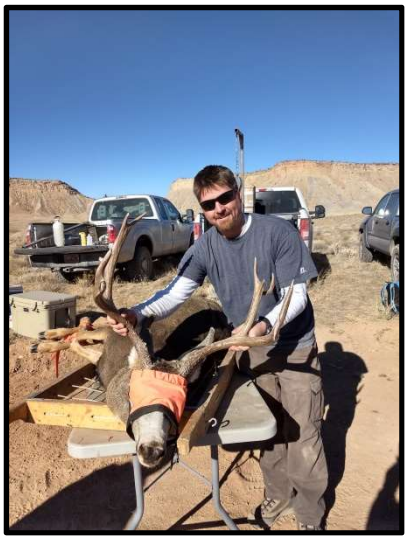
Dr. O'Connor is an ecologist with the Wildfire Risk Management Group at the US Forest Service Rocky Mountain Research Station. His current work is focused on developing spatially explicit risk-based tools that support integrating operational fire response with sustainable landscape planning, fire responder safety, and efficient resource use. His research background in disturbance ecology draws from forest ecology, fire science, entomology, dendrochronology, ecological risk assessment, and spatial analysis and modeling. He holds a BS from Penn State University, an MS from the University of Quebec at Montreal, and a PhD from the University of Arizona.

UTAH CHAPTER
of The Wildlife Society

2018 Nominees for the Utah Chapter of TWS Board

PRESIDENT ELECT:

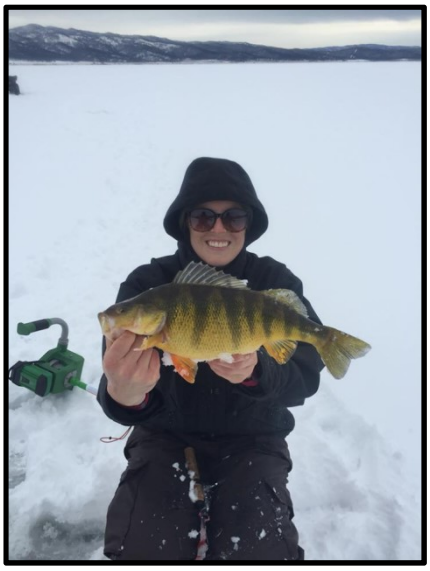
Steve Slater – Steve Slater is the Conservation Science Director at HawkWatch International (HWI), where he's had the great fortune of "working" for the past 12 years. Steve spends much of his work life obsessing over Golden Eagles, whether it be keeping track of the many eagles he has fitted with backpack transmitters, poring over photos of eagles flushing from roadkill in response to passing vehicles, facilitating the Utah Eagle Working Group, helping to inform development-siting decisions, or supporting various USFWS Western Golden Eagle Team initiates. He also oversees HawkWatch's various raptor research and monitoring programs, serves on the Utah BLM Resource Advisory Council (on his second 3-year term), and provides raptor-related outreach and support services to the DoD, BLM, USFS, UDWR, industry, and more. Steve received his M.S. and Ph.D. degrees from the University of Wyoming, studying greater sage-grouse and riparian bird communities, respectively, after emigrating from Michigan in the year 2000. The father of boys aged 8, 5, and 1.5 years old, Steve doesn't really have what you might call personal "free time", but he does his best to keep his kids outside camping, hiking, and playing with real objects. In a past life, he enjoyed mountain biking, snowboarding, fly-fishing, reading, meditating, sleeping through the night, and other selfish, time-consuming activities.



Daniel Olsen – Daniel Olson is the Utah Migration Initiative coordinator for the Division of Wildlife Resources. He has two boys and a lovely wife, all of which love to travel, especially to Hawaii. He grew up hunting, fishing and camping in Salmon, Idaho. The beauty of the landscape and abundance of wildlife there helped foster a deep interest in wildlife that lead him to choose a career as a biologist. As an undergraduate at Brigham Young University, he had the opportunity to study a sage grouse population in Strawberry Valley that was brought back from the brink of extinction by augmenting the population. As a master's student at Brigham Young University, he helped the DWR reintroduce and monitor bighorn sheep on the Stansbury Mountains. Prior to the reintroduction, bighorns had not been in that area for over 100 years. In 2008, he joined the USGS Cooperative Research Unit at Utah State University to work on doctoral project examining the effects of roads on mule deer in Utah. Since 2017, he has been the Utah Migration Initiative coordinator where he is helping build a program that documents and preserves movement corridors for wildlife throughout Utah.

SECRETARY:

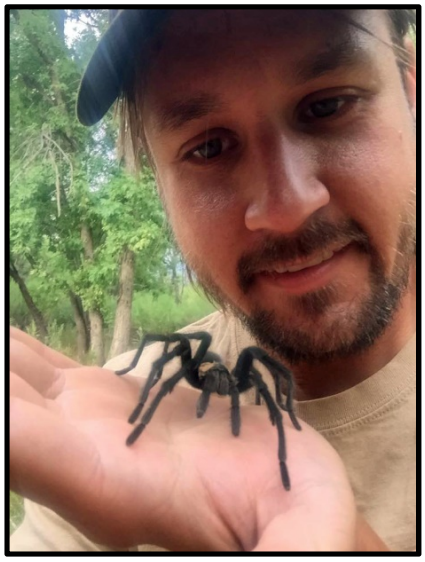
Amy Vande Voort – Amy Vande Voort is a Wildlife Biologist II for the Utah Division of Wildlife Resources in the Northeastern Region. She grew up on a dairy farm in Wisconsin and received a Bachelor's degree from University of Wisconsin-Madison in Wildlife Ecology and a degree in Plant Pathology. As an undergrad and for 2 years after, she worked in various states, including Montana, New Mexico, Colorado, Pennsylvania, and Utah, on various projects. Projects included working with grizzly bears, New Mexico spotted owls, sage grouse, and white-tailed deer, among other species. After receiving a full-time position with Utah DWR managing the Walk-In Access Program in Vernal, she obtained her Master's degree through Utah State assessing habitat nest characteristics and using Forest Inventory and Analysis data to predict Lewis's woodpecker nesting habitat throughout Utah. After being Walk-In Access manager, she did a short stint as a district biologist in the Northern Region before returning to the Northeastern Region, where she has been managing the best district in the state going on 6 years, including the best little known Waterfowl Management Area, Browns Park. She is an avid Green Bay Packers and Wisconsin Badgers fan and loves to hunt and trap anything legal. She's had the opportunity to hunt and harvest cougar, black bear, mountain goat, and mule deer while in Utah, as well as small game and waterfowl. Most days she can be found, if she can be found, outside with her two dogs. She loves to hike, backpack, hunt, travel, and garden.



Chante' Lundskog – Chante' Lundskog is a Wildlife Recreation Specialist for the Utah Division of Wildlife Resources. She received a water polo scholarship to Concordia University, Irvine in California where she completed her Bachelor's degree in biology. Chante' was Concordia University Women's Water Polo Team starting goalie and was awarded Rookie of the Year and the Associate of Collegiate Water Polo Coaches Women's All-Academic Award. While training five hours a day in the pool and always reeking of chlorine, she managed to pursue an undergraduate research project studying the morphological effects of UV-B radiation on Arabidopsis thaliana growth and development. Chante' then went on to complete her Master's degree in GIS from the University of Utah where she evaluated moose habitat in Utah, and recently just graduated in May of 2017. Chante' works closely with a myriad of people at the Division, assisting with any project that could use an extra hand. In her free time, Chante' is an avid angler and fishes any chance she gets. During the summer, she can be found every weekend at Strawberry Reservoir fishing for Kokanee Salmon. While during the winter, she can be found fishing on the ice. Chante' has a goal to catch 600 perch this ice fishing season and currently has caught 379 perch. She says if you want to catch fish and not "zzzz's," your best bet is to go fishing with her.

TREASURER:

Darren DeBloois – Darren DeBloois is the current Mammals Program Coordinator for the Utah Division of Wildlife Resources. He has Bachelors and Master's Degrees from Utah State University. Darren has worked for DWR for 20 years and has filled many roles including Information Technician, Dedicated Hunter Program Coordinator, Biometrician, Cache District Biologist and Assistant Regional Wildlife Manager in the Northern Region. Darren lives in Cache Valley with his wife, four kids and two dogs. He enjoys hiking, hunting, drawing and making music.



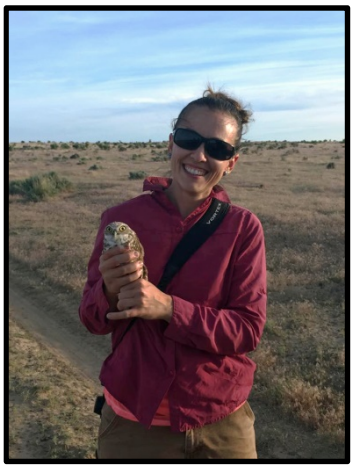
Adam Brewerton – Adam Brewerton is the Wildlife Conservation Biologist for the Utah Division of Wildlife Resources' Northern Region. He is responsible for the management and monitoring of the birds and mammals with special conservation concerns. Adam has been working with the Division for 9 years conducting bird surveys, small mammal trapping and bat surveys. He grew up in northern Utah and has been interested and studying the wildlife of Utah for his whole life. He got his degree in Avian Ecology from Utah State University studying the bird community of the sagebrush desert in west-central Utah. He loves the outdoors, hiking, biking, rafting, and can't imagine a better job.

WEBMASTER:

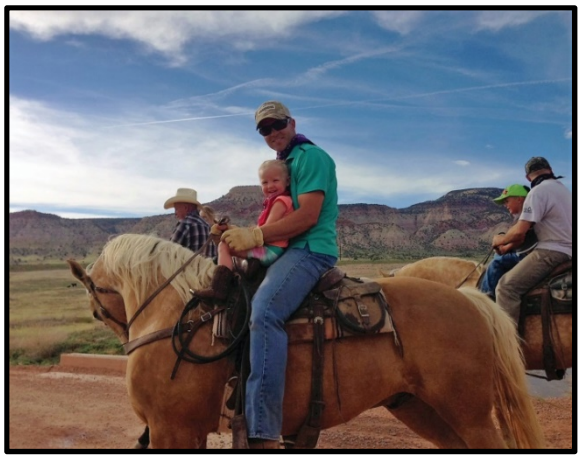
Mary Pendergast – Mary is an ecologist and conservation biologist with 13 years of field work and research experience with the Great Basin and Western shrub-steppe and montane ecosystems, whose Ph.D. focused on community ecology in Utah shrub-steppe. As the staff ecologist and conservation biologist for Wild Utah Project, Mary provides biological analyses for agencies, local working groups, and other nonprofit organizations. She presents research, develops manuscripts for publication, and produces and/or reviews conservation analyses in preparation for status reviews, listing petitions, and land management plans. She also engages in and oversees data collection efforts such as traditional research projects in coordination with Universities and novel graduate research, undergraduate internships, and citizen science programs. Her recent project work includes being an active member of

the Mountain Accord Project's Environmental Systems Group, a member and author involved in the UDWR Wildlife Action Plan steering committee for the state of Utah, and organizing citizen/student science Bioblitz efforts in the Cottonwood Canyons in collaboration with the University of Utah and Westminster College, UDWR, USFS, the Natural History Museum of Utah, Hogle Zoo and other partners. She has worked as a consultant throughout Utah and neighboring states where she coordinated and conducted biological resource studies and habitat assessments with various stakeholders including federal and state agency biologists, the public, non-profit conservation firms, and project developers. While engaging in the NEPA process for major transmission projects in Utah, Wyoming, and Colorado, she prepared Biological Specialist Reports and Biological Evaluations for multiple national forests as well as special status species mitigation and conservation plans. Additionally, Mary is an adjunct faculty member at Westminster College where she teaches ecology, organismal and evolutionary biology, and field biology courses. In her free time she likes to trail run, mountain bike, backcountry split board, and get out in Utah's deserts and mountains with her husband and two dogs.

EVEN-YEAR BOARD MEMBER:



Leah Lewis – Leah was raised as a lifelong Air Force brat and was stationed to Utah in 2003. She spent several years hiking the desert canyons across southern Utah studying Mexican Spotted Owl habitat for her Master's degree at Utah State University. She is witty, passionate, hardworking, and employs a diverse mindset to every challenge. To say she is obsessed with birds is an understatement. Leah currently holds the Big Year record for Uintah County with 222 species of birds documented in eBird, but only managed the second Big Year record in Cache County with 244 species. Leah currently works for BLM as the Greater Sage-Grouse Biologist for the Green River District. She loves to talk and coordinate with others, so be sure to introduce yourself!



Nicholas Brown – Nick grew up on a dairy farm and small cattle ranch in Richfield, Utah which opened the door to a love of the outdoors. Riding horses, herding cattle, and hunting on the Pahvant Mountain were regular life events, with sports covering most everything else. In high school, he was part of state championship teams in both football and track. At Weber State University he received his B.S. in Zoology, focusing on wildlife management. After graduation he was offered a job as a biologist with Select Engineering Services leading a field crew for 9 years, assisting Hill AFB in managing their natural resources on 1 million acres. Switching gears, Nick began working for the U.S. Fish and Wildlife Service out of the Utah FWCO in 2014, as a fish and wildlife biologist. Working as a liaison to Hill AFB through an interagency assistance agreement, he provides technical expertise to Hill AFB, and sneaks away on larger USFWS projects. Once the uniform comes off, family life takes over; whether it's coaching football, getting the kids out hunting, or yes, even watching dance performances…family comes first.

Detailed Meeting Schedule

Note: Names of presenters are provided below, full authorships are included in the abstracts on the online version

Wednesday, March 21st		
Morning	**Field Trips** **Utah Field House – Behind the Scenes** **Red Canyon Bighorn Sheep Viewing** **Bison Tour in the Book Cliffs**	**See Website for Specific Details**
11:00 AM	**TWS Registration**	
1:00 PM	**Welcome to TWS Meeting** Riley Peck, UT TWS Chapter President	**Paradise Room**
1:15 PM	**Opening Remarks** Mike Fowlks, Director Utah Division of Wildlife Resources	
1:30 PM	**Welcome to Vernal** Doug Hammond, Mayor, Vernal, UT	
1:45 PM	**Invited Speaker** Ashley Kijowski, Wildlife Biologist, Great Salt Lake Ecosystem Project	
2:45 PM	**Break**	
3:00 PM	**Invited Speaker** Dr. Robert R. Gillies, Professor of Climate in Plants, Soils and Climate, Utah State University; Director – Utah Climate Center; State Climatologist	**Paradise Room**
4:00 PM	**Invited Speaker** Dr. Christopher (Kit) O'Connor, Ecologist, Wildfire Risk Management Group, US Forest Service Rocky Mountain Research Station	
5:00 PM	**Adjourn until evening events** *Dinner on your own*	
6:00-8:00 PM	**Vernal Brewery Tours**	
7:00 PM	**TWS Social** *Light refreshments and appetizers*	**Paradise Room**
7:30 PM	**Utah TWS Quiz Bowl** Dr. Randy Larsen	

Thursday, March 22nd		
7:30 AM	**TWS Registration**	
8:00 AM	**Announcements and TWS Business** Riley Peck - Chapter President	**Paradise Room**
Session Moderator: Daniel Olsen (President-Elect – Nominee)		
8:15 AM	**Utah Migration Initiative** Daniel Olsen, Don Wiley	
9:00 AM	**Efficiently prioritizing landscape management on the basis of ecological vulnerabilities** Jeffrey Haight	

9:20 AM	**Updates on the science of wildlife and roads in Utah** Patricia Cramer	
9:40 AM	**Improving Establishment of Big Sagebrush (Artemisia tridentata) from Seeding in Utah** Danny Summers	
10:00 AM	**Harmful algal blooms and their impacts on wildlife** Stephanie Graham	
10:20 AM	**BREAK**	
Session Moderator: Steve Slater (President-Elect – Nominee)		**Paradise Room**
10:35 AM	**Golden Eagle movement and seasonal use areas in Utah** Steve Slater	
10:55 AM	**Forest Grouse Ecology and Management in the Bear River Range, Utah** Skyler Farnsworth	
11:15 AM	**How many brine shrimp do eared grebes need to eat daily and why does this make eared grebes a vulnerable species?** Michael Conover	
11:35 AM	**IMBCR program overview, introduction to the Avian Data Center (ADC) and applications for Utah** Jennifer Timmer	
12:05 PM	**LUNCH** *On your own*	
Session Moderator: Leah Lewis (Even-year Board Member – Nominee)		**Paradise Room**
1:15 PM	**BYU TWS Chapter Update - TBD**	
1:30 PM	**Three Years of Cougar Monitoring Using Noninvasive Methods in the Bear River Mountains** Margaret A. Hallerud	
1:50 PM	**The impacts of winter ticks on Utah moose** Sam Robertson	
2:10 PM	**Survival and Cause-Specific Mortality of Elk (*Cervus canadensis*) In Central Utah** Maksim Sergeyev	
2:30 PM	**Long-term evaluation of bighorn sheep augmentations: implications for habitat use and range expansion** Rusty Robinson	
2:50 PM	**USU TWS Chapter Update - TBD**	
3:05 PM	**BREAK**	
Session Moderator: Nick Brown (Even year Board Member – Nominee)		
3:20 PM	**Bison restoration in the East Tavaputs Plateau: the first decade in the Books** Dax Mangus	

3:40 PM	**Assessment Of Factors Associated With Moose-Vehicle Collisions And Their Relationship To Moose Seasonal Movements In The Matanuska and Susitna Valleys Of Alaska** Lucian R. McDonald	**Paradise Room**
4:00 PM	**A Mixture of Butorphanol, Azaperone, and Medetomidine for the Immobilization of American Beavers (*Castor canadensis*)** Annette Roug	
4:20 PM	**Wildlife damage to crops: perceptions of agricultural and wildlife professionals in 1957, 1987, and 2017** Erin Butikofer	
4:40 PM	**Mapping utility of drone-acquired imagery: detecting potential Northern Leatherside chub pool habitat of yellow creek, Evanston, Wyoming** Emanuel Vasquez	
5:00 PM	**Adjourn for poster session & evening events**	

POSTER SESSION		
5:00 PM	**A Citizen Science Approach to Ecological Study and Conservation of the Central Wasatch Range Mammal Community Along an Urban-wildland Interface** Austin Green	**Mezzanine**
	A Study of Bobcat on the Hill Air Force Base, Utah Test and Training Range Kyle Muncey	
	American Black Bear (*Ursus americanus*) Density, Diet, and Distribution near Moab, Utah Sydney Rae Stephens	
	Black Bears in Southern Utah: Movements, Home Ranges, Habitat Relationships, and Relationships to Anthropogenic Landscape Features R. Adriana Dungan	
	Blind spots in habitat coverage of Utah's Breeding Bird Survey Routes Maxfield Carlin	
	Citizen Science Generated Aquatic Habitat Assessments and Boreal Toad Surveys: Building Data Gathering Capacity and Supporting State and Federal Agencies in Filling Data Gaps in the Central Wasatch and Throughout UT Kayleigh Mullen	
	Eared Grebe (*Podiceps nigricollis*) Movements on the Great Salt Lake During the Fall of 2017 Leah Delahoussaye	

	Fighting the light: An analysis of light pollution's effect on migratory birds in Salt Lake City Ellis Juhlin	
	Generating Minimum Population Size Estimates for Brown Bears In Eastern Turkey Using Multilocus Genotyping Bryce Alex	
	Hunters and Elk: Does Weapon Type Influence Rates of Wounding Loss? Levi Watkins	
	Identifying Factors Associated with Eagle Vehicle Strike Risk Steve Slater	
	Instantaneous Sampling: a Less Invasive Approach to Estimating Population Size with Imagery of Unmarked Animals B.J. Adams	
	Natural Springs Inventory and Assessment in Utah's West Desert Danielle Finlayson	
	The Effects of Dixie Harrow on Sage-grouse Habitat: Is Treated Sagebrush Tasty? Jason Wood	
	Using Camera Traps to Investigate Wildlife Crossings on Seep Ridge Road in Uintah County, Utah Kailea Rasmussen	
6:30 PM	**Awards Banquet (Food and Raffle and Awards Oh My!)**	**Paradise Room**

Friday, March 23rd		
7:30 AM	**TWS Registration**	
8:00 AM	**UT TWS Announcements**	**Paradise Room**
Session Moderator: Amy Vande Voort (Secretary – Nominee)		
8:10 AM	**Utah's Sage-Grouse Compensatory Mitigation Program** Alan Clark	
8:30 AM	**Utah Specific Sage-grouse Habitat Guidelines** David Dahlgren	
8:50 AM	**Manipulating Grouse Populations: Translocation, Reintroduction, and Artificial Insemination** Kade Lazenby	
9:10 AM	**A state-wide tool for assisting management actions in sage-grouse country** Michel Kohl	
9:30 AM	**Greater Sage-grouse Use of Habitat Restoration Projects Located Within the Sheeprock Sage-grouse Management Area** Melissa Chelak	

9:50 AM	***UT TWS Chapter Business Meeting*** Riley Peck	
10:20 AM	**BREAK**	
Session Moderator: Chante' Lundskog (Secretary – Nominee)		**Paradise Room**
10:35 AM	**Using Satellite-Derived Estimates of Plant Phenology to Map Sage Grouse Nesting Dates Across an Elevational Gradient** David Stoner	
10:55 AM	**The effects of electric power lines on the breeding ecology of greater sage-grouse** Michel Kohl	
11:15 AM	**Sage-Grouse Definitely Avoid Trees, or Do They? A Case for Providing a Surrogate Niche** David Dahlgren	
11:35 AM	**Using Systematic Conservation Planning to Assess Management Strategies For Two of Utah's Native Cutthroat Trout Subspecies** Andy Witt	
11:55 AM	**Meeting Adjourned – See you Next Year!**	

UTTWS 2018 PAPER AND POSTER ABSTRACTS

THURSDAY, MARCH 22, 2018

THE UTAH MIGRATION INITIATIVE: DOCUMENTING AND PRESERVING MOVEMENT CORRIDORS FOR WILDLIFE

Daniel Olson[1] and Don Wiley[1]
[1]Utah Division of Wildlife Resources, Salt Lake City, UT 84116

Many wildlife species in Utah migrate seasonally in response to changes in the natural environment. For example, mule deer in Utah may move over 60 miles between summer and winter ranges, spending nearly a month migrating one way. Pelicans that inhabit the Great Salt Lake for part of the year move hundreds of miles to Mexico and back. Utah, however, is undergoing significant changes as it is the fastest growing state in the United States, and the population is projected to nearly double in the next 50 years. Rapid human population growth is increasing demands for water, housing, energy, and transportation, which can negatively affect wildlife. Currently is it critical to understand how species move and use their habitats, so those movements and habitats can be preserved as the infrastructure is expanded to accommodate the growing human population. The Utah Migration Initiative was founded in 2017 as a statewide campaign to identify, preserve, and enhance movement pathways for fish and wildlife. The Initiative is a coalition of state and federal agencies, cities, counties, universities, and nongovernmental organizations. The Initiative is using state-of-the-art GPS tracking technology to monitor the movements of a wide variety of species in the state from bison to birds. It is also developing tools to analyze and share movement data, so the information can be put into the hands of biologist, planners and decision makers. By documenting movement of patterns of fish and wildlife species across the state, we hope to preserve the movements of species and keep their populations healthy and abundant.

EFFICIENTLY PRIORITIZING LANDSCAPE MANAGEMENT ON THE BASIS OF ECOLOGICAL VULNERABILITIES

Jeffrey Haight and Edd Hammill[1]
[1]Department of Watershed Sciences, Utah State University, Logan, UT 84321

Natural resource management in the face of environmental risks requires quantification of spatial differences in how plant and wildlife populations are expected experience those risks. When prioritizing management actions across a landscape, it is often prudent to focus on areas of relatively low risk and vulnerability to change (refugia). Quantifying an area's exposure to shifting environmental conditions is key to assessing its relative vulnerability. This can be done through the calculation of climate velocity, the rate at which organisms must travel in order to persist within their climate envelopes given some projected shift in climatic parameters. While climate velocity and related indicators of ecological vulnerability can alone aid in the identification of refugia, relatively little has been done to incorporate them into the broader decision-making frameworks that address management goals (e.g. species protection) and factors affecting the likelihood of achieving those goals. By enabling one to integrate a wide variety of social-ecological variables, systematic landscape planning strategies can improve the efficiency of the process of selecting refugia for management action. We estimated climate vulnerability within the Southern Rockies region by independently calculating climate velocities based on select bioclimatic variables. We then used the software program Marxan to prioritize areas of minimal climate vulnerability while additionally accounting for the presence of species of interest, existing protected areas, and development risks. Our model framework successfully identified priority refugia that were within the spatial extents of the region's threatened wildlife species. Accounting for risks to management success served to further identify the highest priority areas. Our results highlight the need for more thorough assessment of factors that contribute to ecological vulnerabilities in the future. We hope that the results and

framework we outline here will aid managers in efficiently allocating resources with the goal of promoting ecological resilience.

UPDATES ON THE SCIENCE OF WILDILFE AND ROADS IN UTAH

Patricia Cramer[1]
[1]Independent Wildlife Researcher, Logan, Utah 84321

Utah Division of Wildlife Resources (UDWR) and Utah Department of Transportation (UDOT) work together to find the most effective wildlife mitigation on roads to help reduce wildlife-vehicle collisions and provide wildlife connectivity. Research on crossing structures, fences, escape ramps, and wildlife guards continues to reveal various levels of effectiveness of these efforts. The results of several wildlife and roads research projects will be presented to inform wildlife professionals in their efforts to provide wildlife connectivity in the face of roads. The US 89 Kanab-Paunsaugunt study answered the question, 'Can mule deer be trained to move their line of migration?' Through the use of camera traps along 11 miles of wildlife fence and seven crossing structures, we found that an inadequate culvert in a location where mule deer were known to cross US 89, did not function for the majority of mule deer. However, within two years, the number of mule deer attempting to use this culvert decreased and mule deer use of structures one mile to the west, and two miles to the east increased. The answer to this question was, yes. In another study we evaluated double cattle guards, wildlife guards, single cattle guards, electric mats, and electric pavement. Our recommendations are to continue to use double cattle guards and wildlife guards to deter mule deer and other wildlife from entering the road right of way at fence breaks, and wait to deploy electric based technology. The 'best' culvert and bridge dimensions will be presented with various mule deer and elk rates of success and repellence at structures. The range of acceptable values of success rates and repellence rates will be presented, based on performance measures created from 10 years of wildlife monitoring at dozens of structures in Montana and Utah. Future work and trends will also be presented.

IMPROVING ESTABLISHMENT OF BIG SAGEBRUSH (ARTEMISIA TRIDENTATA) FROM SEEDING IN UTAH

Danny Summers[1], **Kevin Gunnell**[1], **and Melissa Landeen**[1]
[1]Utah Division of Wildlife Resources, Great Basin Research Center and Seed Warehouse,
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Big sagebrush (*Artemisia tridentata*) has been seeded on rangeland treatments and wildfires throughout Utah for the enhancement of watersheds and wildlife habitat. Examination of vegetation monitoring data collected from across Utah and other studies in the west have shown limited success from seeding of big sagebrush when seeded following a rangeland treatment or wildfire. To test the impact of seeding rate and timing we seeded Wyoming big sagebrush over the winters of 2015-2016 and 2016-2017 at 12 different rates every two weeks from fall through spring at two locations. Seedlings were counted in the spring of 2016 and 2017 to determine the impact that seeding rate and timing had on germination rates. Initial results show that timing and rates likely influence big sagebrush seeding establishment and success, and that some recommended current practices may need to be revised for increased success of sagebrush seedings.

HARMFUL ALGAL BLOOMS AND THEIR IMPACTS ON WILDLIFE

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Harmful algal blooms (HABs) are becoming more prevalent in both fresh and salt water systems and are an increasing public health and conservation concern. During HAB events, environmental conditions lead to extreme growth of algae that produce toxins, such as cyanotoxins, which can be harmful to fish, wildlife, and humans. Although HAB events are known to be associated with nutrient load, available sunlight, warm water temperature, and lack of water turbidity, it is difficult to reliably predict when or where a HAB event will occur. Cyanotoxin concentration can vary throughout the water column and presence of cyanotoxins can rapidly fluctuate throughout water systems. Direct contact with or consumption of cyanotoxins can lead to disease and mortality of fish and wildlife. Onset of symptoms is often very rapid, can vary based on toxin concentration and type of exposure, and may include the nervous, gastrointestinal, urinary, and reproductive systems of the affected host. In recent years, several cases of HABs with high concentrations of cyanotoxins have occurred in Utah. During one HAB event that caused significant fish and wildlife mortalities, microcystin concentrations as high as 60,000 µg/L were detected in water samples by Enzyme Linked Immunosorbent Assay. State, local, and federal partnerships have been developed to more effectively address HABs and mortality events. Through these partnerships, rapid response and testing of fish and wildlife is available.

GOLDEN EAGLE MOVEMENT AND SEASONAL USE AREAS IN UTAH

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A total of 53 solar GPS transmitters were deployed on nestling Golden Eagles (*Aquila Chrysaetos*) in western Utah between 2013 and 2017 by the Department of Defense and HawkWatch International to study post-fledgling survival and movement ecology. First-year eagle survival after transmitter deployment at 7–8 weeks age averaged 50% overall, but ranged from 25–75% over the years. Young eagles were generally found within 6 km of their nest until 2 months after fledge age, after which average distances increased substantially (i.e., dispersal generally occurred). The majority of eagles surviving >1 year established at least 2 distinct seasonal areas of use, most frequently contained within Utah, but multiple eagles also ranged as widely as Canada and Mexico. We developed a Utah statewide grid containing 4x4-km cells and counted individual eagles occurring in each cell during 4 seasonal periods of interest: summer/fall (Jul 1–Nov15), winter (Nov 16–Feb 15), spring/non-breeding (Feb 16–Jun 30), and spring/breeding (same period, but limited to eagles exhibiting territorial behavior). We also mapped areas of high nesting importance, based on modeling of existing nest records and identification of territories with higher than average breeding activity over the past 10 years. We identified important seasonal Golden Eagle use areas within Utah as containing multiple, adjacent cells used by >1 marked eagle, or prime nesting habitat. Additionally, we overlaid seasonally important areas on each other, and on terrain, water features, fire history, and human activity polygons to highlight potential conservation targets. We will also color band eagle nestlings during the 2018 breeding season in nests near desert springs and guzzlers with camera traps to augment our understanding of post-fledgling eagle survival and seasonal attraction to such features.

FOREST GROUSE ECOLOGY AND MANAGEMENT IN THE BEAR RIVER RANGE, UTAH

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Dusky grouse (*Dendragapus obscurus*; formerly called blue grouse) and ruffed grouse (*Bonasa umbellus*) are an important upland game resource in Utah and in the Intermountain West. There is a lack of basic knowledge of dusky grouse life history and management across the species range, including Utah. Research began in the spring of 2016 in the Bear River Range, Utah. Our objectives were to further our knowledge of forest grouse populations by developing a breeding season population index, characterize seasonal habitat types, understand the relationship between habitat selection and livestock grazing, and understand forest grouse harvest rates. A forest grouse breeding survey protocol was established and walking survey routes were completed in spring 2016 and 2017. Forest grouse were captured via walk-in traps, noose poles, and the use of pointing dogs for initial detection. All captured grouse received an aluminum leg band and captured dusky grouse were fitted with VHF or GPS-PTT transmitters. Micro-site vegetation characteristics were collected at dusky grouse nest and brood sites and paired random locations. We conducted utilization surveys at the end of the grazing season using stratified transects across pastures. Hunters voluntarily placed grouse wings in wing collection barrels at major exits to the forest in Logan and Blacksmith Fork Canyons during the forest grouse hunting season. Resource selection was determined at the third order for breeding forest grouse and for brooding dusky grouse. Final results are currently being analyzed. Information from this study and continuing research based upon our work will help assess specific management practices for this species.

HOW MANY BRINE SHRIMP DO EARED GREBES NEED TO EAT DAILY AND WHY DOES THIS MAKE EARED GREBES A VULNERABLE SPECIES?

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Several million eared grebes (*Podiceps nigricollis*) spend the fall on the Great Salt Lake (GSL), foraging on the lake's vast quantities of brine shrimp. I used an energetic model to determine how many brine shrimp a grebe must consume daily to survive. I found that an eared grebe has a daily energy need of 391 kJ; this requires the daily consumption of about 25,000 brine shrimp. An additional 2,500 to 5,000 shrimp must be consumed daily to obtain enough energy to migrate to Mexico for the winter. To obtain this high harvest rate, grebes need brine shrimp densities on the GSL to exceed 400 shrimp/m^3. Water diversion in Utah increases the risk that brine shrimp population in the GSL will collapse during some future drought. This, in turn, will cause the collapse of the GSL grebe population.

IMBCR PROGRAM OVERVIEW, INTRODUCTION TO THE AVIAN DATA CENTER (ADC) AND APPLICATIONS FOR UTAH

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Every year in late spring and summer, biologists and technicians traipse across mountains, prairies and deserts to survey birds under the Integrated Monitoring in Bird Conservation Regions (IMBCR) program. The program, coordinated by Bird Conservancy of the Rockies, is one of the largest of its kind in North America, stretching across public and private land in many states in the western United States. Utah joined the monitoring efforts in 2015. In efforts to increase awareness of the program, this talk will be a brief overview of the IMBCR program as a whole and IMBCR effort in Utah--what the strata look like, sampling effort, and species of greatest concern for which estimates can be obtained through the IMBCR sampling program. We will also present examples of how IMBCR data can be used for management decisions, such as looking at beetle kill impacts on forest guilds, using a decision support tool for sagebrush obligate birds, examining impacts of tamarisk removal & re-vegetation on songbirds, and mapping

predicted species distributions on DoD installations. Finally, there will be a brief demonstration and introduction to the tools found on the Avian Data Center, the collection point for IMBCR data.

THREE YEARS OF COUGAR MONITORING USING NONINVASIVE METHODS IN THE BEAR RIVER MOUNTAINS

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The cougar (*Puma concolor*) is the apex predator throughout Utah, a valued game species, and sometimes a source of human-wildlife conflict. Monitoring cougar populations is necessary to inform management of this species yet their elusive behavior, wide-ranging movements, low densities, and affinity for rugged terrain make studying this species difficult. From 2015 to present, we have used noninvasive methods to monitor cougars in the Bear River Range of northern Utah. Noninvasive methods have increasingly been employed as cost-effective options for monitoring carnivore species but require extensive field effort. Study designs for noninvasive methods must be carefully adjusted to suit the target species and objectives prior to application. We refined camera-trapping methods to target cougars and compared the results of these surveys to traditional tracking surveys. Cougars were detected at more than 20 locations throughout the Bear River Range, with detections generally unique to each survey method. Camera-trapping and tracking were found to be complementary survey methods. Camera-traps were ideal for long temporal scales but limited spatially, while track surveys covered large spatial scales but were limited temporally. Further, camera-traps have the benefit of operating independently of substrate quality and enabling investigation of interactions between cougars and other species. Here, we compare time of day and rates of activity between cougars, humans, mule deer and elk. This project demonstrates multiple applications of monitoring elusive wildlife species using standardized camera-trap surveys. Relevance of camera-trap surveys would, however, be greatly improved by marking individuals within a population to enable estimation of population density, movement patterns, and survival. Lastly, the protocol used in our study could be adjusted slightly for monitoring cougars in other populations.

THE IMPACTS OF WINTER TICKS ON UTAH MOOSE

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Adult moose (*Alces alces*) in Utah have very few predators and are rarely killed by mountain lions (*Puma concolar*). However, there is one predator that may have a substantial impact on moose populations, the winter tick (*Dermacentor albipictus*). This tick benefits from warmer temperatures and mild winters and climate change is likely increasing their abundance. Increased tick abundance may pose a significant threat to moose because heavy infestations can lead to severe anemia, skin irritation, hair loss, reduced foraging time, and ultimately death. They also can reduce fecundity in female moose by depleting their body's resources near the time of parturition. In 2017 and 2018 Utah Division of Wildlife initiated tick counts on captured moose via transects across the shoulder and rump. Moose with higher tick loads at the time of capture were less likely to have a calf at heel and were less likely to have a calf the following summer. Calf recruitment was also lower for moose with higher tick loads; however, this finding was not significant and may be due to a small sample size. Moose in Utah can move up and down elevation gradients and this movement may help the population remain stable and persist in Utah in the face of climate change and increased tick abundance. Moose that live at higher elevations in the late summer-late fall are more likely to have a calf and fewer ticks because ticks are questing at this time. Higher elevations could be acting as refugia for moose by allowing them to avoid ticks. The reduction in ticks could be due to higher snowpack in the spring, cooler temperatures or different vegetation types at higher elevations, and the ability to move to higher elevations could be critical for Utah moose.

SURVIVAL AND CAUSE-SPECIFIC MORTALITY OF ELK (*CERVUS CANADENSIS*) IN CENTRAL UTAH

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The size of animal populations fluctuates with number of births, rate of immigration, rate of emigration, and number of deaths. For many ungulate populations, adult female survival is the most important factor influencing population growth. Thus, increased understanding of survival and causes of mortality for adult females can help with conservation and management. The objectives of our study were to quantify survival rates of female elk (*Cervus canadensis*) and determine cause-specific mortality. We predicted that hunter harvest would be the leading cause of mortality. Further, we predicted that hunters would harvest animals that were more prime-aged and in better condition than elk that succumbed to other predators. From 2015 to 2017, we captured 452 female elk via helicopter net gunning in central Utah. Individuals were fitted with a GPS-transmitting collar that collected a location every 13 hours. When a mortality warning was received, we located collared individuals and determined cause of death within 48 hours whenever possible. We estimated survival using Kaplan-Meier estimates and Cox Proportional Hazard models within an AICc model selection framework to identify covariates that influenced survival. Our best model was consistent survival across years with mean survival of 83.4% (SE = 1.7%) including harvest and 94.9% (SE = 1.1%) without hunters. In decreasing order of importance, sources of elk mortality included human hunters (71.2%), predation (12.0%), vehicle collision (2.4%), disease (0.8%), and unknown causes (10.4%). Based on the top model, neck circumference, body length, and loin fat were negatively associated with survival. Individuals lost to cougar predation were younger and in worse body condition than individuals lost to hunter harvest, suggesting hunters may be removing individuals that have a greater effect on population growth. A thorough understanding of cause-specific mortality and differences in selection preferences between humans and other predators can improve management strategies.

LONG-TERM EVALUATION OF BIGHORN SHEEP AUGMENTATIONS: IMPLICATIONS FOR HABITAT USE AND RANGE EXPANSION

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Monitoring dispersal and habitat use of released ungulates is important to understand success of translocations and reintroductions. Ungulates released into areas already occupied by resident animals may adjust dispersal and home range use based on the presence of resident animals; however, little is known about this dynamic. We monitored the space use of 127 reintroduced female bighorn sheep (*Ovis canadensis*) in three adjacent populations in northern Utah from 2000 to 2009 to investigate if the size and overlap of habitat use by augmented (2007 to 2009) bighorns differed from resident bighorns (2000 to 2007). On Mount Timpanogos, size of seasonal range-use areas (50% core areas and 95% utilization distributions) for resident bighorn sheep were at least 1.2 times larger (range = 1.2—3.8 times larger) than augmented females. Overlap of seasonal space use (50% core areas and 95% utilization distributions) was at least 2.9 times lower (range = 2.9—36 times) than residents for one augmented group (Colorado) compared with an augmented group from Montana and Utah residents. Additionally, augmented bighorns from Colorado shifted space use to areas 333 m (*SE* ± 425 m) higher in elevation. In Rock Canyon, sizes of seasonal range-use areas for resident females were at least 1.2 times smaller (range = 1.2—3.6) than augmented females, and overlap in space use was minimal. Augmented females in Rock Canyon shifted 95% utilization distributions 0.4 km but expanded range by 3.9 km^2. On Mount Nebo, augmented bighorn annual range-use estimates were 1.2 times larger than for resident bighorns.

Overlap in annual space use by augmented females was minimal, augmented females used higher elevations ($\bar{x}$ = 260 m, *SE* ± 304 m), shifted 95% utilization distributions 4.2 km, and expanded range by 6.5 km^2. Our results provide insight regarding how augmented bighorns interact with resident animals and use habitat after releases.

BISON RESTORATION IN THE EAST TAVAPUTS PLATEAU: THE FIRST DECADE IN THE BOOKS

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In 1990 the Utah Division of Wildlife Resources (UDWR), Bureau of Land Management, The Nature Conservancy and the Rocky Mountain Elk Foundation began work on "The Book Cliffs Initiative". The initiative was developed to take an ecosystem function approach to multiple use land management. Through the initiative, several key parcels of private land were acquired by the UDWR. Management strategies, including livestock grazing, were adjusted to enhance wildlife values and facilitate restoration of native species. From the onset, bison restoration was a high priority. After a lengthy planning process, the Utah Wildlife Board approved the Book Cliffs bison plan in 2007. The first bison transplant occurred in August of 2008 with the release of 14 animals. Over the next 2 years the UDWR released an additional 71 bison on public lands. The Book Cliffs bison population has grown to approximately 350 animals. Managing free-ranging, wild bison has provided unique opportunities and challenges. Bison distribution, migration and habitat use makes managing water and range resources complex and has led to escalating conflicts with livestock permitees both on and off the Book Cliffs unit. Concurrent bison restoration efforts and management by the Ute Tribe on neighboring reservation lands has also added to the complexity of managing this population. As the bison population approaches objective, some of these issues seem to intensify. Despite the challenges, this population presents an expanding opportunity to sportsmen and bison conservation stakeholders. Hopefully, managers can reflect on the experiences and lessons learned in first decade of bison management to glean insights and anticipate issues to successfully navigate the future of bison conservation and management in the Book Cliffs and elsewhere.

ASSESSMENT OF FACTORS ASSOCIATED WITH MOOSE-VEHICLE COLLISIONS AND THEIR RELATIONSHIP TO MOOSE SEASONAL MOVEMENTS IN THE MATANUSKA AND SUSITNA VALLEYS OF ALASKA

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Wildlife-vehicle collisions WVCs) are a major public safety threat for motorists and can involve almost any wildlife species. In Alaska, most WVCs involve Alaskan moose (*Alces alces gigas*). Between 2000 and 2012, the Alaska Department of Transportation (ADOT) reported 9,949 moose-vehicle collisions (MVCs) in the state resulting in 23 human fatalities, 118 incapacitating injuries, approximately 1,400 minor injuries, and the mortality of thousands of moose. We are seeking to identify the factors that are associated with increased incident of MVCs including moose movement behaviors. We are collecting site-specific habitat and roadway data at documented MVC locations. These data are being compared to similar data collected at randomly selected sites to determine which factors may contribute to increased MVC risks. As part of the project, the Alaska Department of Fish and Game (ADFG) deployed 60 necklace-style global positioning system radio-transmitters on 45 female and 15 male moose, to better understand of the landscape level movement of moose throughout the increasingly urbanized study area. Findings from the research will be used to guide management efforts of the ADFG and ADOT to mitigate the potential for future MVCs in the Mat-Su borough.

A Mixture of Butorphanol, Azaperone, and Medetomidine for the Immobilization of American Beavers (*Castor canadensis*)

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A total of 58 American beavers (*Castor canadensis*) were immobilized with butorphanol, azaperone, and medetomidine (BAM) for the purpose of health assessments, sex determination, and placement of VHF tail transmitters in a subset of animals. Isoflurane gas anesthesia was available to aid with induction when needed, and all animals received supplementary oxygen. Thirty-one beavers immobilized with a mean (standard deviation, SD) dose of 0.65 (0.15) mg/kg butorphanol, 0.22 (0.05) mg/kg azaperone, and 0.26 (0.06) mg/kg medetomidine did not require supplemental isoflurane during induction and the mean induction time was 8 min (range: 3-21 min). This dose was equivalent to 0.024 (0.005) mL of BAM per kg. A total of 29 beavers that were immobilized with a mean (SD) of 0.51 (0.07) mg/kg butorphanol, 0.17 (0.02) mg/kg azaperone, and 0.2 (0.03) mg/kg medetomidine needed supplementary isoflurane at 5% and 5 L/min for <1 minute to induce full anesthesia. In none of the beavers, did BAM alone provide sufficient depth of anesthesia to drill a hole in the tail for transmitter placement, and supplementary isoflurane was administered to reach a sufficient level of analgesia for the procedure. The beavers were reversed with 5 mg atipamezole per mg medetomidine and 1 mg naltrexone per mg butorphanol. No adverse effects or mortalities were observed. Butorphanol-azaperone-medetomidine can be considered safe for use in American beavers for minor procedures.

Wildlife damage to crops: perceptions of agricultural and wildlife professionals in 1957, 1987, and 2017

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A national survey of wildlife agencies was conducted during 1957 to determine perceptions of wildlife damage to agriculture. This study was repeated during 1987 and also sent to state Farm Bureaus and state Wildlife Extension Specialists. During 2017, we replicated these studies to determine how perceptions had changed over the last 30 and 60 years. During 2017, 22 different wildlife species were listed by >1 respondent as causing the most damage. Several of these species were not listed by any respondents in either of the prior surveys; suggesting that problems caused by these species are new or have increased in severity over the last 30 years. Despite this variation in species causing damage, deer were listed by most respondents as causing the most damage to agriculture in their state. There was close agreement between state wildlife agencies, Farm Bureaus, and Wildlife Extension Specialists on the level of damage caused by wildlife, but wildlife agencies tended to rank damage by big game species higher than the other respondent groups while Wildlife Extension Specials tended to list nuisance species, perhaps because landowners call Wildlife Extension Specialists when they have problems with nuisance species. Most respondents believed that wildlife damage to agriculture had increased during the last 30 years. State Farm Bureaus and Wildlife Extension Specialists had a good grasp of the kind of services and products available from the government to help mitigate wildlife damage on farms and ranches.

MAPPING UTILITY OF DRONE-ACQUIRED IMAGERY: DETECTING POTENTIAL NORTHERN LEATHERSIDE CHUB POOL HABITAT OF YELLOW CREEK, EVANSTON, WYOMING

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Yellow Creek has been identified by the Utah Division of Wildlife Resources (UDWR) as one of the two drainages in the Upper Bear River watershed that contain native, self-sustaining populations of Northern Leatherside Chub NLSC (*Lepdomeda copei)*. During summer 2016, The Utah Chapter of the Nature Conservancy in partnership with UDWR, Trout Unlimited, U.S. Fish and Wildlife, and other government agencies conducted imagery acquisition using drones from the Utah Water Research Laboratory at Utah State University. The main goal of this effort was to collect high resolution imagery (3-6 cms spatial resolution) in a 46 mile stretch of Yellow Creek that could be utilized to determine habitat conditions for NLSC. In 2017, the GIS lab at Wild Utah Project conducted image analyses of the acquired drone-imagery by applying a Normalized Difference Water Index (NDWI) and subsequent geographic information analysis to determine location, size, and spatial distribution of potential NLSC pools along Yellow Creek. The results yielded by this analysis allowed proper identification of 403 potential NSLC pool habitats, and determined their location, concentration and distribution according to land ownership parcel data. With increased popularity of drones for imagery acquisition, the methods used and results obtained in this data analysis could be replicated in other watersheds with comparable datasets and could be applied to identify various habitat conditions and restoration sites.

FRIDAY, MARCH 23, 2018

UTAH'S SAGE-GROUSE COMPENSATORY MITIGATION PROGRAM

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Through the 2013 Sage-grouse Conservation Plan, 2013 Governor's Executive Order and Legislation in 2016, the Department of Natural Resources was directed to establish a Compensatory Mitigation Program for Greater Sage-grouse. The purpose of the program is to offset the impacts of permanent disturbance to habitat by first, encouraging responsible economic development through avoiding and minimizing permanent disturbance within Sage-grouse Management Areas (SGMAs) and second, by providing mitigation resulting in an increase to or protection of habitat to offset the impacts from permanent disturbance. Permanent disturbance is a human caused action that results in a loss of habitat for at least 5 years. The rule establishing the program was developed with extensive public input including numerous public meetings. The most frequent suggestions were: 1) keep it simple, 2) provide options and flexibility for mitigation, 3) include a role for private landowners, and 4) cover all land ownerships in Utah. In addition, two 30-day written comment periods were provided. The final rule was advertised a third time in February, 2018 before final adoption to occur at the end of March. The program provides for three actions to generate credits (a credit equals one acre of habitat) within a SGMA: 1) create functional habitat for sage-grouse adjacent to existing occupied habitat, 2) create corridors linking two areas of occupied habitat to facilitate safe movement, particularly by broods, and 3) protect existing occupied habitat from permanent development through a conservation easement or other mechanism and insure habitat quality is maintained. The Utah Mitigation Program provides three approaches to generate mitigation credits: State Sponsored Program patterned after the Watershed Restoration Initiative, Term Mitigation Credit Program allowing private landowners to develop credits, and Conservation Bank

Program. Although there is some overlap, each approach was designed to address a particular portion of the mitigation need.

UTAH SPECIFIC SAGE-GROUSE HABITAT GUIDELINES

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Greater sage-grouse (Centrocercus urophasianus) use sagebrush (Artemisia spp.) habitats throughout Utah. Habitat guidelines and standards are used by state and federal managers to conserve habitat throughout sage-grouse distribution. Past published guidelines are limited in scope and data supporting them came primarily from more northern latitude sagebrush steppe communities. Most of Utah's sage-grouse habitat occurs in different sagebrush systems, such as sagebrush semi-desert. Thus, past published guidelines may not capture the natural variability in vegetation characteristics of sagebrush systems inhabited by sage-grouse in Utah. We used vegetation data collected at radio-marked sage-grouse locations in past research studies throughout Utah to establish habitat guidelines for breeding and brooding habitats. We used Landfire vegetation data and connected this spatial data to our individual sage-grouse locations and the micro-site (i.e., 30 m) vegetation data measured at the site (e.g., shrub, sagebrush, grass, and forb cover and height). We then used a random forest analysis to identify similar habitat throughout the state based on these site specific vegetation characteristics and then spatially defined clusters. We found that three spatial clusters was optimal for delineating differences but not making guidelines over-convoluted for management implementation. Our habitat clusters differences were primarily driven by elevation gradients. We ended up with clusters of Wasatch (high elevation), Low (low elevation), and Parker (areas on Parker Mountain). Our results can be used to manage for habitat standards that come from locally driven data, making it easier for managers to meet standards and guidelines while maintaining sage-grouse conservation objectives throughout Utah.

MANIPULATING GROUSE POPULATIONS: TRANSLOCATION, REINTRODUCTION, AND ARTIFICIAL INSEMINATION

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Many grouse species around the world are considered imperiled. As populations decrease managers often attempt intervention methods such as translocations to arrest declines, increase numbers, or reestablish populations. Past grouse translocation projects have lacked intensive monitoring efforts necessary to provide key learning processes and adaptive management. To date, no published studies provide assessment of both the translocated and source populations. For those few projects that were monitored, often reproductive efforts, success, and survival of translocated females has been relatively low, especially the first breeding season post-translocation. We are currently participating with other partners to help develop protocols for sage-grouse translocations. Three different projects dealing with imperiled populations are occurring simultaneously in south-west North Dakota, west-central Utah, and the Bi-State population in California. All three studies are incorporating 1) population vital rate monitoring of the translocated and source populations, 2) artificial insemination of a sub-sample of translocated females with control, and 3) soft-release methods using remote release boxes. Our preliminary findings herein are focused on the south-west North Dakota efforts. In April of 2017 we translocated 20 male and 40 female greater sage-grouse from the Stewart Creek population near Rawlins, Wyoming to historical lek sites in south-west North Dakota. All translocated birds were radio-marked, with 20 females receiving necklace-style VHF and 20 females receiving GPS-PTT harness-style radios. Males were fitted with VHF harness-style radios. Movements post-release were generally large, though

total distances varied considerably. Mortality rates were an issue the first few weeks post-release, but decreased with time. Approximately half or more of the females initiated nests, though preliminary information was inconclusive concerning the effects of artificial insemination. Nest success was below average compared to other published findings, but did not necessarily differ from the source population. Brood success showed similar results. We look forward to another translocation effort in the spring of 2018 and future analysis combining our results with the other two collaborating studies.

A STATE-WIDE TOOL FOR ASSISTING MANAGEMENT ACTIONS IN SAGE-GROUSE COUNTRY

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Land managers are consistently in need of up-to-date information on wildlife distributions in order to best prioritize areas for habitat treatments (e.g., conifer removal). In this presentation, we demonstrate the use of a simple resource selection analyses for greater sage-grouse (*Centrocercus urophasianus*; sage-grouse) that can be applied anywhere within Utah to help assist land-manager. In its current state, this product utilizes our state-wide GPS sage-grouse database and a number of habitat covariates to provide a predictive map of habitat selection. From this predictive map, land managers can decide where to place their habitat treatments (e.g., nearest high quality habitat). We will detail the request process from which agency biologists (DWR, USFS, BLM) can access these maps. Beyond this, we will discuss a number of additional products that we will be developing to assist with land management decision as they pertain to sage-grouse management and conservation.

GREATER SAGE-GROUSE USE OF HABITAT RESTORATION PROJECTS LOCATED WITHIN THE SHEEPROCK SAGE-GROUSE MANAGEMENT AREA

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Utah's Watershed Restoration Initiative (WRI) was launched in 2005 is a partnership-driven effort designed to restore, conserve, and manage ecosystems in areas that have been delineated as priority areas across the state. The WRI has completed 1,719 habitat restoration projects on over 1.4 million acres of land in Utah since its conception, with plans to finish and implement more than 310,000 acres in the near future, as described on their website. A large proportion of these projects has been applied to improving greater sage-grouse (*Centrocercus urophasianus*) habitat. In 2013, the State of Utah published the Utah Greater Sage-grouse Conservation Strategy. The strategy identified eleven Sage-Grouse Management Areas (SGMAs) within the state of Utah, which represent the highest sage-grouse breeding density areas and support more than 90% of the combined Utah population of sage-grouse. Of Utah's eleven SGMAs, one has showed continued declines beyond the normal population cycles: the Sheeprock SGMA. As a result of this persistence in population decline, state and federal agencies enacted management strategies that included translocations, habitat restoration, and predator management. With the several WRI habitat restoration projects located within the Sheeprock SGMA as a part of our research, we aim to assess sage-grouse use of the projects through a resource selection function (RSF) of both translocated and resident sage-grouse marked with GPS transmitters. In a RSF performed in late 2017, we found that relative probability of use by marked grouse was 68%. Sage-grouse habitat selection from this study being performed from 2016- 2019 will inform managers where to plan future habitat restoration projects and ultimately aid in preventing the Sheeprock population's extirpation.

USING SATELLITE-DERIVED ESTIMATES OF PLANT PHENOLOGY TO MAP SAGE GROUSE NESTING DATES ACROSS AN ELEVATIONAL GRADIENT

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Understanding the influence of ecosystem phenology on key wildlife species is critical for land-use planning and wildlife conservation in multiple-use landscapes. The greater sage-grouse (Centrocercus urophasianus) is a species of intense management interest across western rangelands. Current objectives for this species include increasing abundance and distribution through habitat restoration. However, a common problem faced by agency personnel is how to plan habitat manipulations and other land-uses around critical life history stages for species of concern. Sage grouse are sensitive to disturbance during the nesting period which can be a source of conflict with other land uses. To address this problem we modeled the timing of sage grouse nesting dates across an elevational gradient in Utah. We used data from > 1,000 nests collected on 13 study sites (1998-2015) to measure variation in the timing of sage grouse nesting with respect to plant phenology. We measured growing-season phenology of sage brush dominated rangelands using daily measures of the Normalized Difference Vegetation Index (NDVI). Sage grouse nest initiation dates occurred progressively later at higher elevations. This pattern closely tracked the start of spring (SOS) by approximately 23 days. Hatching occurs ~ 28 days after laying, and this coincided with the peak-of-season when understory productivity is highest and late-season frosts are unlikely. Managers can use these models to reduce conflicts with competing land uses, or planning habitat restoration efforts to increase sage grouse nest success and juvenile survival.

THE EFFECTS OF ELECTRIC POWER LINES ON THE BREEDING ECOLOGY OF GREATER SAGE-GROUSE

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Anthropogenic infrastructure can negatively affect wildlife. Grassland birds may be particularly vulnerable to tall anthropogenic structures because they evolved in ecosystems void of vertical structures. In the western U.S., electric power transmission and distribution lines occur within the range of the greater sage-grouse (*Centrocercus urophasianus*; sage-grouse). The U.S. Fish and Wildlife Service recommended using buffer zones near leks to mitigate the impacts of power lines on sage-grouse. However, because data are lacking, recommended buffer zones are inconsistent across state and federal agencies. To address this, we evaluated the effects of power lines on sage-grouse breeding ecology within Utah and the surrounding areas from 1998-2013. Power lines negatively affected lek trends and persistence at distances up to 2.7 and 2.8 km, respectively. Female sage-grouse were displaced by transmission lines during the nesting and brooding seasons at distances up to 1.1 and 0.8 km, respectively. Nest and brood success reduced by transmission lines up to distances of 2.6 and 1.1 km, respectively. Distribution lines did not affect sage-grouse habitat selection or reproductive fitness. Moreover, our analyses demonstrated the value of habitat quality in mitigating power line impacts. Thus, conservation planners can minimize the effects of new power lines by

placing them in existing anthropogenic corridors and/or incorporating no surface occupancy buffers within 2.8 km from active leks. However, due to uncertainty across our distribution line models coupled with their role in providing electric power service directly to individual consumers, we recommend application of a 2.8 km buffer on a case-by-case basis for distribution lines. We recommend managers consider habitat protection and restoration as compensatory mitigation where required, and population monitoring as a mitigation feedback mechanism, and that research be conducted to evaluate the role of landscape management practices to mitigate the potential effects of power lines on sage-grouse ecology.

SAGE-GROUSE DEFINITELY AVOID TREES, OR DO THEY? A CASE FOR PROVIDING A SURROGATE NICHE

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Greater sage-grouse (Centrocercus urophasianus) have evolved in the open sagebrush landscapes of the North American West. Generally, sage-grouse are known to avoid tall structures, including tree cover. A popularized, but untested, idea is that sage-grouse avoid tree cover because of the potential for an increase in avian predators and their perch sites the trees provide. While the most recent literature on conifer removal in sagebrush systems supports the removal of trees to benefit sage-grouse, applying these principles uniformly and broadly to general tree cover many not be appropriate. From 1999 to 2009, we radio-marked sage-grouse females on Parker Mountain, in south-central Utah. We followed these females to their nests and brood locations. We noticed that as the brood season progressed we often found radio-marked broods, as well as unmarked broods, associated with aspen (Populus tremuloides) and sagebrush edge. This phenomenon seemed even more frequent during the drier summers. We use our brood location data to perform a resource selection function to better understand how sage-grouse broods were using their brooding habitat in relation to the aspen cover in the area. We found that selection for aspen edge was high in all years as the brood season progressed, however, this selection was even stronger in the dry years when monsoonal moisture was below average. We also found that forb cover increased, especially in dry years, the closer the brood location was to aspen edge. Predation risk was a concern, and we tested to see if those broods that were closer to aspen edge had lower rates of survival. We found that there was no relationship between brood survival and distance to aspen edge, showing that by selecting for this habitat edge the broods did not end up in a habitat sink (i.e., high selection for risky habitat). We suggest that because Parker Mountain does not have wet meadow complexes, like most other sage-grouse populations, that these aspen edges provide a surrogate ecological niche. In other words, this aspen-sagebrush edge provides similar resources as wet meadows normally would for other populations.

USING SYSTEMATIC CONSERVATION PLANNING TO ASSESS MANAGEMENT STRATEGIES FOR TWO OF UTAH'S NATIVE CUTTHROAT TROUT SUBSPECIES

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Sustained trout populations indicate not only suitable local conditions, but also favorable upstream conditions within a drainage basin. However, the widespread historical distribution of native salmonids has been on the decline due to habitat degradation and the presence of non-native trout, resulting in the listing of many populations of salmon and trout across the West under the U.S. Endangered Species Act. Due to the dependency of local trout habitat on upstream conditions, a variety of geographic scales are relevant to scientists tasked with conserving and restoring trout habitat, ranging from local reach scale (within a single basin), to historic distribution across a landscape (spanning multiple river basins). Local stream restoration projects may target improving in-stream features, though some argue that these restoration projects may merely be treating the symptoms and not the cause. Both abiotic and

biotic upslope conditions throughout a basin are likely influential on downstream environments, suggesting basin-wide efforts are prerequisite to addressing issues within local habitat. Using systematic conservation planning techniques, we identified priority conservation watersheds for Bonneville and Colorado River cutthroat trout. Two differing management strategies for incorporating anthropogenic risks were tested to identify priority watersheds based on UDWR conservation objectives. Climatological risks, anthropogenic risks, and ecological risks from non-native trout were considered to address the various scales and issues facing freshwater conservation in Utah. When watersheds with non-native trout were eliminated from selection, overall cutthroat conservation objectives were not achieved. Conversely, goals were achieved when accepting and minimizing risks in basins shared by native cutthroat and non-native trout. Previous work indicates that greater returns on investment are obtained when managers accept a certain amount of risk into their conservation strategies, and acknowledge that future climatological, anthropogenic, and ecological risks will influence conservation efforts. Results also translate to UDWR's quantitative objectives for stream mile protection.

POSTER SESSION

A CITIZEN SCIENCE APPROACH TO ECOLOGICAL STUDY AND CONSERVATION OF THE CENTRAL WASATCH RANGE MAMMAL COMMUNITY ALONG AN URBAN-WILDLAND INTERFACE

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The Central Wasatch Range (CWR) in Northeastern Utah serves as an island-like oasis for wildlife, separating it from surrounding desert and urban sprawl, and is a contributing factor to Utah's position within the top ten most biologically diverse states in the country. However, the CWR also comprises some of the most highly recreated national forests in the country and is the main water source for the Salt Lake Valley, one the fastest growing population in the United States. Consequently, Utah also ranks within the top ten across states in percentage of species at risk of extinction. Amidst increasing anthropogenic development, this habitat and its ability to sustain a rich wildlife community may be in jeopardy. In partnership with multiple universities, Wild Utah Project, The Natural History Museum of Utah, Salt Lake City's Parks and Public Lands Program, the Forest Service, and the Division of Wildlife Resources, we will use motion-activated camera traps and the help of teams of volunteer citizen scientists and University of Utah students to gather data from 195 sites throughout the CWR, monitoring mediumlarge mammals and terrestrial birds. The CWR lines the Salt Lake Valley and has a distinct and prominent Wildland Urban Interface, where each of the major seven canyons experiences a differing level of anthropogenic development. Using this natural gradient, we intend to measure and quantify the effects of urbanization and development on the CWR wildlife community, as well as identify key habitat areas throughout the CWR. Through this work, we will develop a better understanding of how species both use and move through areas under increasing anthropogenic land-use change, which will have lasting implications on both how conservation actions are taken and when and where management strategies are implemented.

A STUDY OF BOBCAT ON THE HILL AIR FORCE BASE, UTAH TEST AND TRAINING RANGE

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Bobcats (*Lynx rufus*) are a highly successful species that has adapted to many habitat types throughout the United States and portions of Mexico and Canada. However, the species is difficult to study due to its elusive nature. Though bobcats have been well studied in portions of their range, relatively little is known about their abundance and

distribution in the extremes of their desert ranges. We used remote cameras within the Hill Air Force Base, Utah Test and Training Range (UTTR) in Utah's West Desert as a method of determining population size and habitat use. Camera trapping grids combined with scent stations were used to "mark" and recapture individuals based on the unique pelage patterns of bobcats, resulting in an estimate of the population size and density. Remote cameras were found to be an effective tool to estimate the size of the population even at the low densities found in this study area. Remote camera data has been paired with various layers in GIS to produce a model of suitable habitat within the UTTR.

AMERICAN BLACK BEAR (URSUS AMERICANUS) DENSITY, DIET, AND DISTRIBUTION NEAR MOAB, UTAH

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After building accounts of encounters with American black bears near the Rio Mesa Field Station near Moab, Utah I am investigating factors that influence the sustainability of these large mammals. With these individuals likely originating from southern populations in the La Sal Mountains, the potential for more black bear migrants increases with rising populations and hunting pressures. Research on the current density, diet and distribution patterns is valuable information in aiding the mitigation of human-wildlife conflict. Camera trap photos gathered during our preliminary study from May-November 2017 confirmed frequent use of canyons in the field station; prints and scat found near riparian areas documented further use of the property. To gather information about diet and density, I'm establishing at least 5 monitoring stations where two opposing camera traps will be facing a scented fur snare. The scent of the fur snare invites investigation by individual bears, increasing the probability of contact. The snare will collect fur from the animal's face, which will later be retrieved and brought back to the University of Utah for stable isotope analysis. Ratios of carbon and nitrogen isotopes allow insight into the general diet of the individual, with implications on how much plants, animals, or human food is a part of their diet. Furthermore, hydrogen and oxygen isotopes between significantly different elevations such as Rio Mesa and the La Sals give noticeable signatures. Well-preserved hairs can infer how much, if any, of an individual's lifespan was spent between the 2 localities. Information on the nutritional behavior and movement of local bears can be valuable tools for approaches to decrease human contact in this highly visited region. I hope for presentation to allow for feedback that brings more insight or potential collaboration in improving this research to be valuable in aiding bear conflict mitigation.

BLACK BEARS IN SOUTHERN UTAH: MOVEMENTS, HOME RANGES, HABITAT RELATIONSHIPS, AND RELATIONSHIPS TO ANTHROPOGENIC LANDSCAPE FEATURES

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American black bears (*Ursus americanus*) populate montane regions of Utah. For the past 30 years, the Utah Division of Wildlife Resources (UDWR) has radio-tagged black bears for the primary purpose of estimating reproductive parameters of the Utah population. In recent years, problems with food-conditioned bears in Bryce Canyon National Park (BCNP) have raised concerns for human and bear safety as well as human food accessibility. We set out to capture and collar black bears on US Forest Service land on the Paunsaugunt Plateau west of BCNP to collect and analyze movement, activity and temperature data of bears moving in around the park. Given the low population density in southern Utah and difficulty of capturing bears, capture efforts spanned 2014 to 2017. Currently, 9 bears

are collared with GPS ATS iridium collars that are providing data. We will generate a clearer understanding of bear habitat relationships, movements, home ranges, and relationships to anthropogenic landscape features in the BCNP area. Initial analysis shows that bears prefer areas with campsites and springs and avoid roads and trails. Hot Spot Analysis identified a general area central to all of BCNP's backcountry campgrounds, but beyond the reach of trails. Determining how bears use this area, we will be better able to educate the public and manage bears for a natural population with minimal human-bear conflicts.

BLIND SPOTS IN HABITAT COVERAGE OF UTAH'S BREEDING BIRD SURVEY ROUTES

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As one of the oldest citizen science projects in the U.S., the North American Breeding Bird Survey (BBS) provides critical long-term, large-scale data on North American bird populations. BBS has many strengths, including cost efficiency, long-running datasets, and its potential for citizen engagement. Data from BBS informs Endangered Species Act listing decisions, and is the only source of population-level information for many species in Utah. However, as with any research project of this magnitude, BBS has limitations that should be assessed and understood. We investigated the spatial distribution of BBS routes across Utah to determine whether land ownership, land cover types, habitat classes and habitat conditions are sampled in proportion to their prevalence throughout the state, and to identify gaps in current route coverage. Using geospatial information from LANDFIRE and GAP, as well as inputs from avian management plans, we measured the proportion of 14 general land cover types, 21 habitat classes and 5 categories of habitat condition inside 400m buffers surrounding the length of 98 of 99 active BBS routes in the state. We compared the habitat type and condition of all BBS routes, as well as subset of routes with high completion rates (≥80% in last 10 years), to available habitat throughout the state. Barren and Pinyon-Juniper habitat was under-represented in BBS routes, while Salt Desert Shrub was over-represented. High-completion routes tend to sample higher-quality and less disturbed habitat at a higher rate than its prevalence across the state. This is true even in habitat types where the opposite trend – that disturbed habitat is over-sampled - is found when all BBS routes are analyzed. Analysis of habitat extent and condition within different ownership and management groupings at regional scales within the state will be helpful in finding solutions for current shortcomings in BBS coverage.

CITIZEN SCIENCE GENERATED AQUATIC HABITAT ASSESSMENTS AND BOREAL TOAD SURVEYS: BUILDING DATA GATHERING CAPACITY AND SUPPORTING STATE AND FEDERAL AGENCIES IN FILLING DATA GAPS IN THE CENTRAL WASATCH AND THROUGHOUT UT

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During the past two decades the boreal toad, *Anaxyrus boreas boreas*, has experienced serious population declines throughout historic toad habitats in Utah, including the Central Wasatch Mountains. Primary threats include; chytrid fungus, water management, livestock grazing, recreation, timber harvest, urbanization, pollutants, and drought/climate change. A recent U.S Fish and Wildlife Species Status Assessment (SSA) resulted in the decision to not list the Eastern Population of boreal toads (CO, ID, NM, UT and WY) under the Endangered Species Act. Despite this recent finding, the unknown effects of climate change on both habitat and population viability were highlighted in the SSA. Effects of climate change on habitat could include changes in habitat availability, water availability, active season days, and distribution of chytrid. Limited long-term data on these issues, matched with limited data on the broader distribution of boreal toads, mean their potential effects on the species remain uncertain. Utah's Hogle Zoo, Wild Utah Project, Utah Division of Wildlife Resources (UDWR), Utah Geological Survey (UGS), and the U.S. National

Forest Service (USFS) have set out to coordinate their boreal toad and associated habitat data gathering efforts, as well as to leverage the power of citizen science-based programs to begin filling some of these data gaps. In the 2017 field season, Wild Utah Project and Utah's Hogle Zoo engaged over 50 citizen scientists, who gathered data at 40 locations statewide, and logged over 1,040 service hours. Using newly standardized methods shared by UDWR, USFS, and UGS, citizen scientists and agencies alike collected aquatic habitat condition data in a consistent fashion that was streamlined for entry into a statewide UGS database. By continuing this coordinated effort and engaging citizen scientists we strive to continue to support state and federal agencies in building data gathering capacity, filling data gaps, and supporting evidence-based management recommendations.

EARED GREBE (*PODICEPS NIGRICOLLIS*) MOVEMENTS ON THE GREAT SALT LAKE DURING THE FALL OF 2017

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The Great Salt Lake is a vital staging location for waterbirds that migrate through the Pacific Flyway. It is here that over 200 species of birds stop and consume their fill of brine shrimp to continue with their migration southward. One of the largest populations of birds on the Great Salt Lake during the fall staging period is the eared grebe. The number of grebes on the Great Salt Lake peaks in October. During their 2-5 month stay, eared grebes undergo a complete molt that renders them flightless. This makes them easy to capture on the Great Salt Lake. We trapped and banded 58 eared grebes, 26 of which were outfitted with VHF transmitters (16 implants, 10 backpacks). Radio telemetry flights were conducted at least once a week, but more if the schedule allowed. Twelve birds were found twice, and 3 birds were detected multiple times. The lakes large size hindered us from gathering more data. Only one mortality was detected over the course of the fall staging period. The largest, straight-line distance traveled by an eared grebe on the Great Salt Lake during the fall of 2017 was 39.4 kilometers over a period of 12 days. Some grebes were detected in the same area of the lake that they were captured and released, while some traveled to opposite ends. This data has provided a basic understanding of the movements of eared grebes on the Great Salt Lake; however, a larger sample size and GPS transmitters could provide a deeper understanding of the population dynamics and any patterns of movement on the Great Salt Lake.

FIGHTING THE LIGHT: AN ANALYSIS OF LIGHT POLLUTION'S EFFECT ON MIGRATORY BIRDS IN SALT LAKE CITY

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Light pollution is a global and rapidly expanding environmental issue threatening human health, natural ecosystems, and millions of migrating songbirds. Light pollution can be fatal for birds, causing them to fly off track and collide with buildings. Urban areas, with their large population densities and brightly lit, tall buildings, are especially dangerous for migrants, and recent efforts have been made in many North American cities to measure and mitigate bird-building collisions. Although Salt Lake City, UT is situated in an important area at the convergence of the Pacific and Central Migratory Flyways, no previous work has assessed the impact of light pollution on birds migrating through Salt Lake. In 2017, Tracy Aviary implemented the Salt Lake Avian Collision Survey (SLACS), a citizen science project where volunteers walked early morning transects around 20 city blocks to identify and collect birds that had collided with buildings overnight. During spring and fall migration, we found 44 birds representing 19 species that had collided with 21 out of 196 sampled buildings. We measured and compared a variety of building characteristics (e.g., height, surrounding vegetation, percent window coverage, and nighttime light levels) at collision sites and an equal number of randomly selected buildings within the study area. Using this information, and in partnership with the Salt Lake Chapter of the International Dark Sky Association, Great Salt Lake Audubon, and a

host of community partners, we are launching Lights Out Salt Lake, an initiative to encourage buildings, businesses, and private residences to turn out unnecessary lighting during peak migration. Similar programs have been implemented in cities with documented avian collisions, and have proved extremely successful. Lights Out Salt Lake aligns human interests with conservation goals and has the potential to make a strong positive impact for all inhabitants of the Salt Lake Valley.

GENERATING MINIMUM POPULATION SIZE ESTIMATES FOR BROWN BEARS IN EASTERN TURKEY USING MULTILOCUS GENOTYPING

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Conflict between humans and large carnivores in Turkey is increasing as rapid urbanization brings more of the country's diverse ecosystems into contact with human settlements and infrastructure. Despite the risks Turkey's large carnivores face, conservation efforts remain impeded by the poor documentation of local carnivore populations. Estimates of population size and trends remain unavailable for many large carnivore populations in the region. Using a microsatellite analysis of scat samples, we obtained a minimum size estimate for a population of Eurasian brown bear (*Ursus arctos arctos*) in the Sarıkamış-Allahuekber Mountains National Park, eastern Turkey. From 2013-2015, scat detection dogs from the University of Washington's Center for Conservation Biology's Conservation Canines were used to collect bear scat samples. DNA was extracted following sample collection. For each sample, 8 different microsatellite loci were amplified using polymerase chain reaction and 8 primer pairs targeting each loci. An Applied Biosystems 3730xl capillary sequencer was used to distinguish alleles at each loci by fragment length. Each sample was subsequently associated with a set of alleles at each loci, or a "multilocus genotype". We collected 1,520 bear scat samples across all years and identified 157 viable bear samples to genotype. Logistic constraints were a limiting factor in our ability to generate enough data for capture-recapture analysis; therefore we focused on generating a minimum population estimate in the main study area. Taking a multilocus genotyping approach, our results identified 27 unique multilocus genotypes, which suggests a minimum population size of 27 bears. Our estimate can be used to investigate other indicators of population health, such as population density and genetic diversity, and will aid conservation efforts seeking to mitigate conflict as this brown bear population becomes increasingly exposed to human-dominated landscapes.

HUNTERS AND ELK: DOES WEAPON TYPE INFLUENCE RATES OF WOUNDING LOSS?

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Hunting is an outdoor activity enjoyed by many, and is a strategy used by wildlife managers to regulate population size of some species. Elk (*Cervus canadensis*) is a big game species that is hunted throughout western North America. Hunting is one of the leading causes of adult mortality in this species. On occasion, there is wounding loss when elk are not recovered or do not die quickly and move away from where they were wounded. Wounding loss can remain unaccounted for when managers determine harvest rates. It is anecdotally thought that archery hunters cause proportionally more wounding loss because their weapons are less powerful and require more precision to quickly kill elk when compared to rifle hunters. Our objective was to determine if there is a difference in rates of wounding loss among weapon types. For three years during February (2015-2017), we captured 452 elk by net-gunning from a helicopter. Each elk was fitted with a GPS/VHF collar that had a preset fix-frequency of 13 hours. In addition, we collected basic data including body measurements, body condition score, age, fecal, and blood samples before release. When a mortality notification was received, we attempted to find the animal and determine cause of death within 72

hours. We determined the number of elk harvested and the number of wounding losses during the archery and rifle seasons. Wounding loss accounted for 20% of hunter-related mortalities and there was no difference between archery and rifle weapon types (z = .3, p =.37).

IDENTIFYING FACTORS ASSOCIATED WITH EAGLE VEHICLE STRIKE RISK

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Roads represent a danger for both Bald Eagles (*Haliaeetus leucocephalus*) and Golden Eagles (*Aquila chrysaetos*) in the western U.S., primarily in relation to foraging on road-killed wildlife. Vehicle strike risk for eagles is generally greater during fall and winter months, when live prey is less available, big game species move to lower elevations, and eagles are more gregarious. We report on the first 2 years of a planned 4-year study of fall and winter eagle activity and mortality along roadways in central Utah and southeastern Oregon. We performed repeated driving surveys to record all available carcasses and sightings of live eagles, walking and dog surveys of right-of-ways to detect additional carcasses, and placed camera traps on a subset of carcasses to quantify eagle use patterns. Within Utah, a minimum of 19 eagle mortalities were found on or near roadways during the completed 2 field seasons (we are awaiting final dog survey results from this year that are expected to reveal additional eagle mortalities). Live eagle density, carcass feeding observations, and eagle mortality locations in both Utah and Oregon were spatially correlated with hotspots of available roadkill. Camera traps placed opportunistically on roadside carcasses captured well over >15,000 eagle use photos, which are still being tallied and reviewed. Ultimately, our goal is to identify activity patterns and flushing thresholds of eagles in relation to distance to road, road characteristics, and vehicle type, to help guide roadkill carcass relocation schedules and distances that will minimize eagle vehicle strikes. Additionally, we will generate correction factors that will allow more realistic estimates of fall and winter eagle mortality associated with specific road characteristics and roadkill densities. These products will facilitate the quantification of eagle "savings" achievable under various roadway management scenarios.

INSTANTANEOUS SAMPLING: A LESS INVASIVE APPROACH TO ESTIMATING POPULATION SIZE WITH IMAGERY OF UNMARKED ANIMALS

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Effective management of wildlife benefits from accurate and unbiased estimates of population size. However, traditional approaches to estimation of population size can be invasive, risky, and expensive. Remote cameras have become popular as a flexible and less-invasive option for estimating population size through methods like photographic capture-recapture (CR). Because most ungulates do not have individual pelage patterns, CR is limited for these taxa without first capturing and marking animals for future identification. To address this limitation, new methodologies are being developed that do not rely on marked animals. Our objective was to test these methods and estimate population size utilizing imagery of unmarked animals obtained from remote camera traps. More specifically, we sampled population density at multiple moments in time, otherwise known as instantaneous sampling (IS). During June through October 2017, we deployed 95 remote cameras at random locations to detect feral sheep (*Ovis aries* and *O. gmelini musimon*) found throughout the Pu'u Wa'awa'a and Pu'u Anahulu game management areas on the island of Hawai'i. We programmed cameras to trigger every 15 minutes. We also programmed cameras to trigger with infrared and motion sensors in order to provide a comparison CR dataset. Utilizing two weeks of continuous imagery from June to July of 2017, we generated a preliminary estimate of 1654 sheep (95% CI ± 395). Imagery from the same time period was not sufficient for reliable CR estimates. We are currently processing a

backlog of 800,000+ images to obtain a suitable CR dataset for comparison. In the event that CR and IS estimates have overlapping confidence intervals, we would propose that IS be considered as a less-invasive, less-risky, and inexpensive approach to estimating population size.

NATURAL SPRINGS INVENTORY AND ASSESSMENT IN UTAH'S WEST DESERT

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Water influences patterns and processes for life in arid environments. Riparian systems are some of the most productive and diverse areas in arid regions, and are essential for the survival of many plant and animal species. Consequently, degradation and loss of natural water features such as springs can be a major threat to desert ecosystems. Climate change, increasing use of water resources by humans, and invasive species will further strain riparian systems in the coming decades. In anticipation of these changes, we are starting a project to conduct an inventory and baseline assessment of natural springs in Utah's west desert. Our objective is to quantify the current state of 182 desert springs and identify factors associated with metrics of spring health and condition. We will conduct this study in the Great Basin Desert at Dugway Proving Ground (DPG) and within the surrounding Military Operations Area (MOA) of western Utah. Specifically, we will conduct a rapid assessment at each spring during the hottest months of the summer (July and August). Protocol will include collection of soil, water samples (to assess water quality), measurement of flow, vegetation transects, bird point-counts, etc. We will also take photos of each site and install remote cameras to capture wildlife use. Additionally, we will use GIS to evaluate the composition and makeup of the landscape around the springs including elevation, slope, aspect, and vegetation type. Using these attributes we will analyze similarities between springs to determine if any of these are correlated with spring condition. With these data we will then quantify overall condition of the springs, identify species use and diversity, and evaluate the relationship between the two. Our results will allow us to predict what factors are associated with healthy springs and how to replicate those conditions for the future preservation of desert springs.

THE EFFECTS OF DIXIE HARROW ON SAGE-GROUSE HABITAT: IS TREATED SAGEBRUSH TASTY?

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Understanding how species respond to management actions can help improve conservation planning. Dixie Harrow is a habitat restoration method that managers use in sagebrush (Artemisia sp.) habitats to increase forb production, a staple in the diet of greater sage-grouse (Centrocercus urophasianus) during spring and summer. These treatments, however, may influence the quantity and quality of sagebrush available to greater sage-grouse, hereafter sage-grouse. Sagebrush comprises >99% of the diet for sagegrouse during winter, and sage-grouse are known to base their selection of winter forage on nutritional composition of sagebrush. Thus, retention of high quality sagebrush is crucial to conservation of this species. Our objective was to quantify the relationship between Dixie Harrow treatments, forage quality, and habitat selection by sage-grouse during winter. We met this objective by 1) evaluating selection by sage-grouse for or against Dixie Harrow treatments and 2) assessing the nutritional composition of sagebrush within treated and untreated areas. To evaluate selection for or against treatments, we captured 67 sage-grouse between March 2016 and November 2017, and fitted them with GPS transmitters. To assess the role of nutrition in selection of sagebrush, we collected samples of sagebrush from treated and untreated areas (n = 58). From these samples we measured concentrations of primary and secondary compounds to identify the nutritional quality of sagebrush. We

found that sage-grouse showed significant preference for treated areas in winter ($p < 0.01$). Sagebrush in treated areas had 1.5% higher percent crude protein ($p < 0.01$), 0.6% higher percent hemicellulose ($p < 0.01$), and was 3.35 uMol/gram lower in coumarin concentration ($p < 0.01$). Our results suggest that during the winter of 2016/2017 sage-grouse preferred habitats treated by Dixie Harrow, and that these treatments increased nutritional quality of sagebrush for sage-grouse by increasing crude protein and hemicellulose while decreasing coumarin concentration.

USING CAMERA TRAPS TO INVESTIGATE WILDLIFE CROSSINGS ON SEEP RIDGE ROAD IN UINTAH COUNTY, UTAH

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Wildlife crossings, which allow wildlife to pass over or under a road used by motorized vehicles, are an important tool in wildlife management and conservation. The two main goals of this tool are to connect fragmented habitat and to decrease the frequency of collisions between wildlife and vehicles. Collisions not only pose risks to wildlife, but also may cause human injury or damage to property**.** Wildlife crossings are increasingly being used, especially here in Utah, to connect habitat, but more research is needed to understand how different species use wildlife crossings across time and space. We looked at six wildlife underpasses located along Seep Ridge Road, a 45-mile-long, newly paved access into the energy zone of southern Uintah County. We investigated patterns in wildlife use of underpasses between species along diel and annual time scales from 2013 – 2016 to understand the effectiveness of these wildlife crossings. We documented 21 different species (wild and domestic) encountering the wildlife underpasses with mule deer, domestic cow, elk, and coyote being the most common, respectively. Mule deer were by far the most common, accounting for 71.5% of the 8,920 total documented encounters. Notably, we documented bison successfully using several of these underpasses. 52.9% of encounters, across all species and all years, resulted in individuals successfully using the wildlife crossing at Seep Ridge Road. As we continue monitoring wildlife crossing, we hope our work will guide management of wildlife in this area that may face increasing development pressures in the future.

Thank You

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