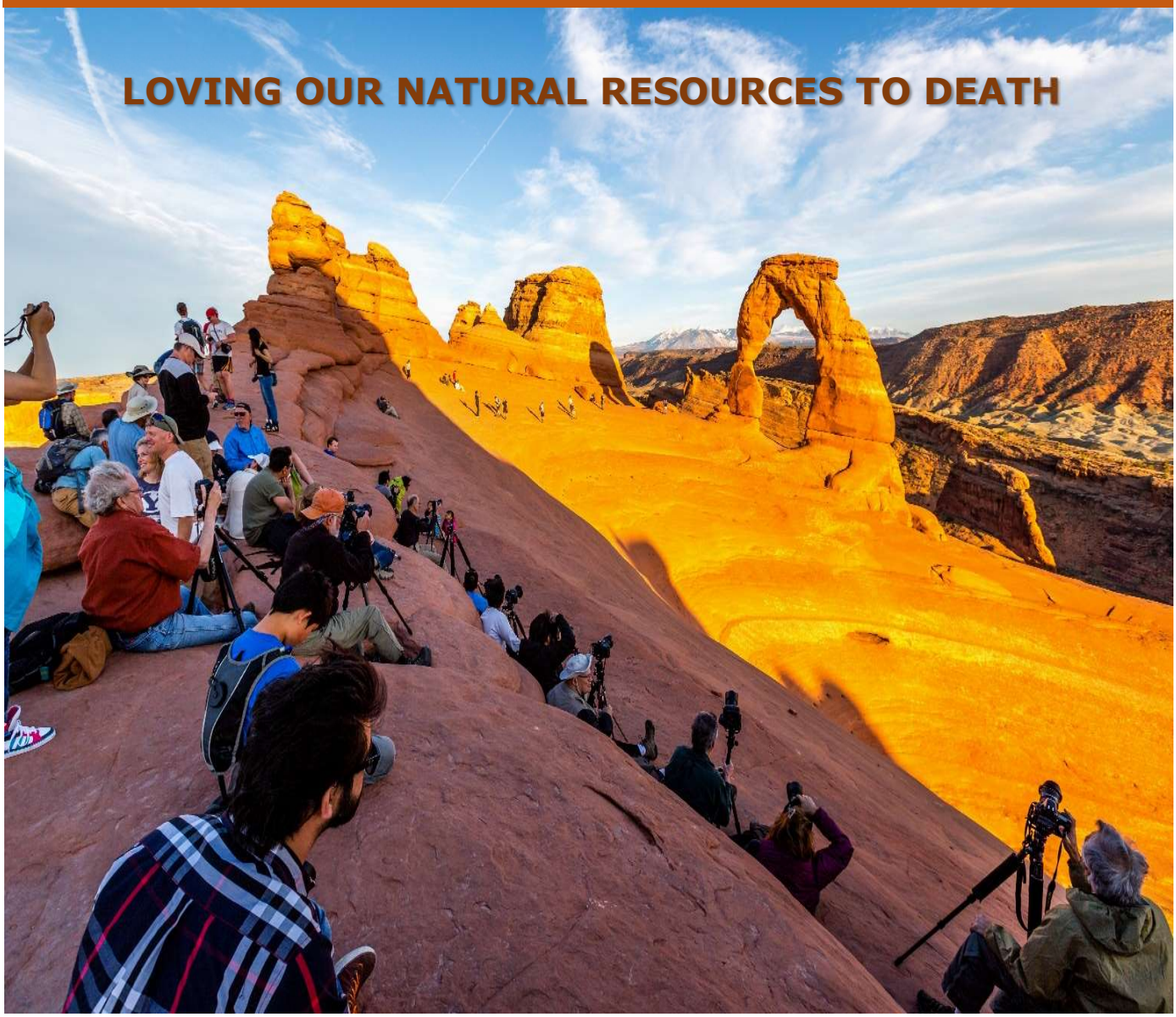
Utah Chapter of The Wildlife Society

Annual Meeting

2019

March 20-22, Springdale, Utah



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UTAH CHAPTER OF THE WILDLIFE SOCIETY

1965-2019

ANNUAL MEETING

Springdale, UT

March 20-22, 2019

UTAH CHAPTER BOARD MEMBERS

Riley Peck, Past-President
Stephanie Graham, President
Daniel Olson, President-elect
Amy Vande Voort, Secretary
Darren DeBloois, Treasurer
Keeli Marvel, Odd-Year Member
Nicholas Brown, Even-Year Member
Mary Pendergast, Webmaster

Schedule at a Glance

Wednesday, March 20th SpringHill Marriot	
7:00 AM	FIELD TRIPS
11:00 AM	TWS Registration
1:00 PM	Welcome and Plenary Session
2:30 PM	BREAK
2:50 PM	Plenary Session
5:00 PM	Adjourn until evening events
7:00 PM	TWS Social and Quiz Bowl (SpringHill Marriott)
Thursday, March 21st Springhill Marriott	
7:30 AM	TWS Registration
8:00 AM	Technical Session
10:00 AM	BREAK
10:20 AM	Technical Session
11:40 PM	LUNCH
1:00 PM	Technical Session
3:10 PM	BREAK
3:30 PM	Technical Session
4:50 PM	Adjourn for poster session & evening events
6:30 PM	Awards Banquet – (SpringHill Marriott)
Friday, March 22nd Canyon Community Center	
8:00 AM	TWS Registration
8:30 AM	Technical Session
10:00 AM	BREAK
10:20 AM	Technical Session
12:00 AM	Meeting Adjourned

A Big THANK YOU to all our 2019 Sponsors!

Other Sponsors

Treasures by Ticia
Bagley Honey
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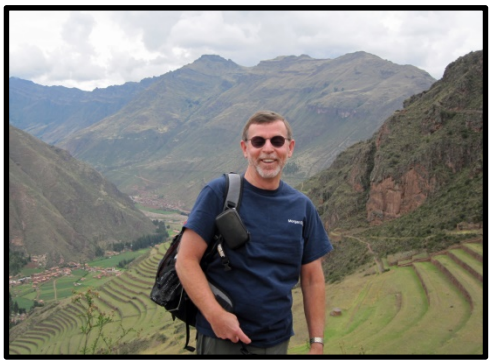
Plenary Session

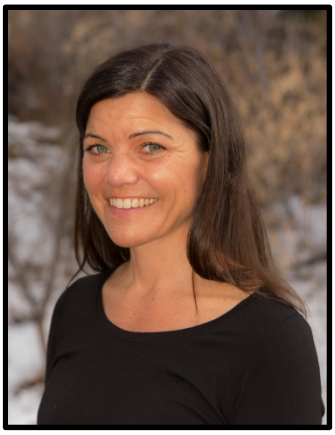
2019 Theme: Loving our Natural Resources to Death

The 2019 meeting theme evokes a long-held concern of wildlife and habitat managers as well as conservation scientists. Throughout Utah, but perhaps most notably demonstrated by the annual record-breaking visitation numbers to the State's national parks, we see the striking juxtaposition of in-tact and connected habitats supporting native wildlife species against development and disturbance that are a direct result of anthropocentric activity on the same landscape. Whether analyzing impacts of recreation, agriculture, or energy development our speakers this year were selected to discuss not only impacts of 'loving our natural resources to death' but opportunities to restore them and strike a balance between multiple landscape uses and conservation planning.



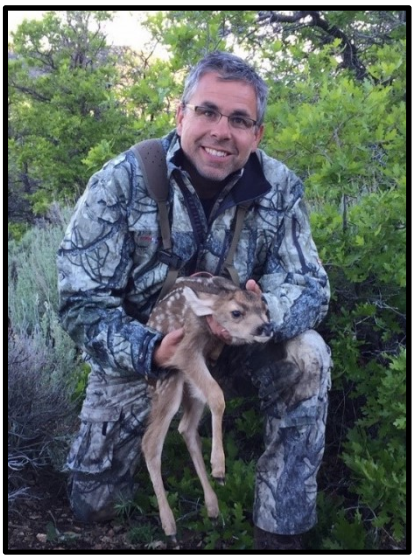
JEFFREY BRADYBAUGH, Superintendent, Zion National Park

Jeff Bradybaugh has worked for the National Park Service for more than 36 years: as a Natural Resources Specialist at Theodore Roosevelt National Park in North Dakota, Mammoth Cave National Park in Kentucky, and Zion National Park. He has served as Superintendent at Grand Canyon-Parashant National Monument on the Arizona Strip co-managed among the BLM and NPS, Superintendent of Bryce Canyon National Park, and currently Superintendent here at Zion National Park. Jeff holds a MS degree in Wildlife Sciences from New Mexico State University and feels fortunate to have lived here in SW Utah for the past 21 years. He has been a member of The Wildlife Society since 1982.



DR. JULIE YOUNG, Associate Professor, Supervisory Research Wildlife Biologist

Julie Young, Ph.D., is a Supervisory Research Wildlife Biologist for USDA-National Wildlife Research Center's Predator Research Facility and an Associate Professor in the Department of Wildland Resources at Utah State University. She received two B.S. degrees from Texas A&M University, an M.S. from Iowa State University, where she studied territorial fidelity of guanacos in Chile, and a PhD from Utah State University, where she studied spatial ecology of coyotes in Texas. Julie left Utah upon graduating for postdocs at Arizona State University and Wildlife Conservation Society and for a permanent position as a Research Ecologist for Institute for Wildlife Studies before being pulled back to Utah in 2010. Her research focuses on behavior, ecology, and management of mammalian carnivores. She utilizes wild and captive carnivore populations to understand and reduce human-wildlife conflict. She is the first female scientist to be a Field Station Leader for NWRC and is a co-founder of the 500 Women Scientist Logan Pod.



DR. BROCK MCMILLAN, Professor of Wildlife Ecology, Department of Plant and Wildlife Sciences, Brigham Young University.

Brock grew up in northern Utah and earned his B.S. in Biology at Utah State University. He received both his M.S. and Ph.D. in Ecology at Kansas State University. He worked as a member of the faculty at Minnesota State University for nine years before returning to Utah and taking his current position at BYU in 2008. His professional passions include teaching and mentoring students, and studying the ecology of wildlife—mammals in particular. In his personal life, he enjoys spending time with his family, travelling, and anything outdoors. His personal passion is pursuing mule deer. Brock's research has been focused on a variety of mammal ecology questions ranging from assemblage ecology of small mammals to reintroduction and population ecology of mesocarnivores to population ecology of ungulates to community-level effects of exotic and feral species such as the feral horse.

JUSTIN SHANNON, Wildlife Section Chief, Utah Division of Wildlife Resources

Justin Shannon graduated from Brigham Young University in 2007 with a bachelor's degree in Wildlife and Wildlands Conservation. In 2008, he graduated with his Master's degree from the same school, where he researched survival rates and habitat use of translocated bighorn sheep.

Justin has been employed by the Utah Division of Wildlife Resources for 11 years. He started out as a wildlife biologist in the central and southeast portions of the state. He was promoted to a regional wildlife manager in 2009, where he spent time managing wildlife in Southeastern Utah and working with some incredible biologists.

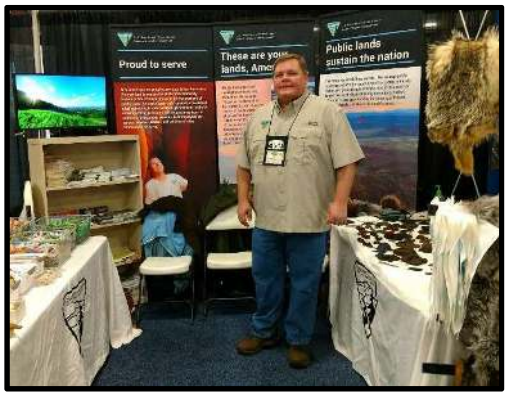
In 2013, Justin was promoted to big game program coordinator and was responsible for managing big game species throughout Utah. In 2017, Justin was promoted to wildlife section chief where he currently oversees the wildlife program for the State of Utah.

In his spare time, Justin enjoys fishing, hunting, camping, pilates, reading, working on his family's ranch, and spending time with his friends, wife Caley, and four boys.

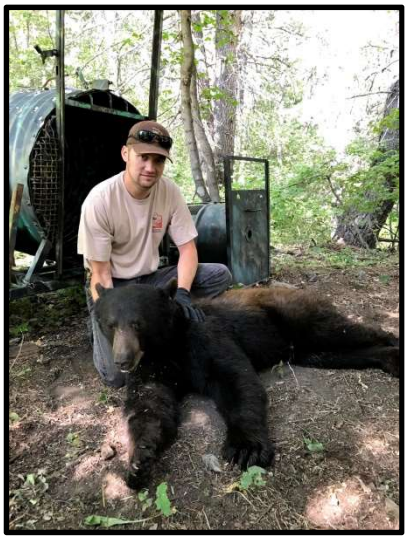
UTAH CHAPTER
of The Wildlife Society

2019 Nominees for the Utah Chapter of TWS Board

PRESIDENT ELECT:

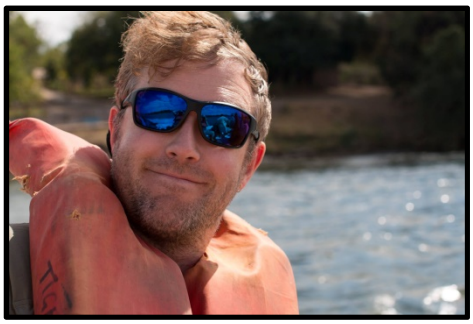


DAVE COOK – Dave is the Utah State Biologist for the BLM and the DOI Secretarial Order 3362 Migration Liaison for Colorado, Utah and Wyoming. Dave grew up in Utah fishing, hunting, and camping with his dad. Dave has a terrific wife, daughter, and son with whom he shares his love of the outdoors. Both kids fish, camp, hunt, and shoot clays. Dave is also the coach for his son's ice hockey team, The Olympic Oval Dawgs. Dave has worked for 28 years as a biologist for the states of Utah and Texas with the last 10 with BLM. He knows which job is harder federal or state biologist. He studied fisheries and wildlife biology at the University of Idaho and Ethology at Texas A&M.



JOSEE SEAMONS – Josee currently works for UDWR as the Predator Specialist in the central region. He manages the coyote bounty for the region, as well as working heavily with human/wildlife conflicts along the Wasatch Front. Josee has worked for the Division since 2009 in both the habitat and wildlife sections. He received a Bachelor of Science in Biology from Utah Valley University in 2014. He is currently enrolled in the Master of Natural Resources program at Utah State University. Josee grew up between Utah, Wyoming, and Montana where he found an early love for hunting, fishing, and camping. He has a beautiful wife and a 2 year-old son. When not hunting or working, Josee and his family enjoy visiting the National Parks of the western states.

ODD-YEAR BOARD MEMBER:



EDD HAMMILL – Edd is an Assistant Professor at Utah State University, where his research focuses on optimizing wildlife management decisions. Most recently, he led a project that identified the management areas in Utah that would be most resilient to changes in rainfall and temperature, but also contained species of interest. Prior to this project, Edd worked on a large multidisciplinary project tasked with the most appropriate flow regime for the Diamond Fork river system. Before undertaking work in Utah, Edd led a large international project that quantified how the risk of armed conflict could be incorporated into conservation planning in Africa. The results of this project showed that the best strategy for wildlife management was to quantify, and account for, the risks of conservation actions failing, but not necessarily avoid risky management strategies. His lab group is currently working on two large projects, one tasked with optimizing the placement of low tech river restorations in Utah, and the other pioneering the use of environmental DNA techniques to model the distributions of cryptic amphibian species. Edd currently mentors two PhD students and Masters' students. His early life was spent on a beef farm in the northern UK, before moving to Scotland to complete Undergraduate and Masters Degrees. When not at work, he enjoys biking in the mountains, fishing, and skiing.

COOPER FARR – Cooper Farr is the Director of Conservation at Tracy Aviary, where she coordinates Tracy Aviary's many avian conservation initiatives, allocates grants through Tracy Aviary's Conservation Fund program, and implements a number of citizen/community science projects throughout Salt Lake County. She monitors birds in key local habitats, such as the region's critically important riparian areas, and investigates pressing conservation issues, such as the impact of urban light pollution on migrating birds. Cooper has been interested in applied wildlife conservation throughout her career. She earned a Master's degree at Colorado State University, where she studied bird and mammal habitat use and community composition in Conservation Development subdivisions. Before CSU, she spent several years doing field research on a number of species, including Rafinesque's big-eared bats in Kentucky, greater sage-grouse and raptors in Wyoming, and fox squirrels, coyotes, and white-tailed deer in North Carolina. In her free time, Cooper enjoys fostering dogs (and sometimes adopting them), hiking, camping, playing guitar, and falling down while attempting to use her new cross-country skis.

Detailed Meeting Schedule

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

Wednesday, March 20th		
Morning	**Field Trips** **Birding Local Hotspots** **Zion National Park Bighorn Sheep Viewing**	**See Website for Specific Details**
11:00 AM	**TWS Registration**	
1:00 PM	**Welcome to TWS Meeting** Stephanie Graham, UTTWS Chapter President	**SpringHill Marriott**
1:15 PM	**Opening Remarks** Ashley Green, Assistant Director, UDWR	
1:30 PM	**Welcome to Springdale** Stanley J. Smith, Mayor, Springdale, UT	
1:45 PM	**Invited Speaker** Jeffrey Bradybaugh, Superintendent, Zion National Park	
2:30 PM	**Break**	
2:50 PM	**Invited Speaker** Dr. Julie Young, Ph.D., Supervisory Research Wildlife Biologist for USDA-National Wildlife Research Center's Predator Research Facility and Associate Professor in the Dept of Wildland Resources at USU	**SpringHill Marriott**
3:35 PM	**Invited Speaker** Dr. Brock McMillan, Professor of Wildlife Ecology, Department of Plant and Wildlife Sciences, Brigham Young University	
4:15 PM	**Invited Speaker** Justin Shannon, Wildlife Section Chief, Utah Division of Wildlife Resources	
5:00 PM	*Dinner on your own*	
7:00 PM	**TWS Social** *Light refreshments*	**SpringHill Marriott**
7:30 PM	**Utah TWS Quiz Bowl**	

Thursday, March 21st		
7:30 AM	**TWS Registration**	
8:00 AM	**Announcements and TWS Business** Stephanie Graham – UTTWS President	**SpringHill Marriott**
Session Moderator: Dave Cook (President-Elect Nominee)		
8:10 AM	**Monitoring Natural Resources in the Space Age: Applications of Satellite Imagery for Wildlife Management in the Mountain West** David Stoner	
8:30 AM	**Remote Camera Surveys to Inventory and Monitor Wildlife In Cedar Breaks National Monument** Ethan Hammer	
8:50 AM	**Instantaneous Sampling and Photographic Capture-Recapture: Comparing Estimates of Population Size for Techniques Using Remote Cameras** B.J. Adams	
9:10 AM	**Conservation in the 21st Century: The Balancing Act Between Science, Politics, and the Law** Braden Sheppard and Covy Jones	
9:40 AM	**Panel Discussion** Braden Sheppard, Covy Jones, Justin Shannon, Jace Taylor, Troy Forrest	
10:00 AM	**BREAK**	
Session Moderator: Josee Seamons (President-Elect Nominee)		**SpringHill Marriott**
10:20 AM	**The Utah Wildlife Migration Initiative: Managing Real-Time Movement Data** Daniel Olson	
10:40 AM	**Secretarial Order 3362 – Big Game Migration Update** Dave Cook	
11:00 AM	**Influence of Prewinter Nutritional Condition and Age on Rates and Cause of Mortality of Mule Deer** Kent Hersey	
11:20 AM	**Sage-grouse Movements in a Grazing Landscape** Hailey Wayment	
11:40 PM	**LUNCH** *On your own*	
Session Moderator: Edd Hammill (Odd-year Board Member Nominee)		**SpringHill Marriott**
1:00 PM	***USU TWS Chapter Update***	
1:20 PM	**Surviving the Hunts: Three Very Old Female Black Bears from Utah and Minnesota** Hal L. Black	

1:50 PM	**Wasatch Wildlife Watch: Understanding the Ecological Relationships Between Cougars (Puma concolor), Their Prey, and Humans Along Two Wildland-Urban Interfaces** Lauren Newton, Tim Cromwell, Joe Calwell, Natalie D'Souza, and Katie Christensen	**SpringHill Marriott**
2:10 PM	**Modeling Carnivore Interactions in Northeastern Oregon Using Activity and Occupancy Patterns** Rylee Jensen	
2:30 PM	**IMBCR Bird Monitoring – Applications for Military Installations** Keeli Marvel	
2:50 PM	***BYU TWS Chapter Update***	
3:10 PM	**BREAK**	
Session Moderator: Cooper Farr (Odd-Year Board Member Nominee)		**SpringHill Marriott**
3:30 PM	**TWS Plains and Mountains Section Update** Bob Lanka	
3:50 PM	**Hawkwatch Studies of Urban Raptor Ecology, With an Emphasis on the American Kestrel** Steve Slater	
4:10 PM	**Impact of Multiple Biological and Ecological Factors on the Survival of Translocated Chukars in Northwestern Utah** R. Justin Bingham	
4:30 PM	**Five Important Considerations for Sage-grouse Translocations: A Case Study from Utah's West Desert** Terry Mesmer	
4:50 PM	**Adjourn for poster session & evening events**	

POSTER SESSION		
5:00 PM	**Using Drones To Improve Efficiency of Waterfowl Surveys at Pariette Wetland in Northeastern Utah** Tyler Elgiar and Kailea Rasmussen	**SpringHill Marriott**
	An Inventory and Assessment of Natural Springs in Utah's Great Basin: Factors Associated with Wildlife Diversity Danielle Finlayson	
	Evaluating the Accuracy of Estimating Age Using Patterns in Tooth Wear for Mule Deer and Rocky Mountain Elk Morgan Hinton	
	Modeling the Effect of Explosive Weaponry Testing on Golden Eagle Nest Site Selection and Reproductive Success Benjamin Hoose and Hannah Hoose	
	Using High-resolution sUAS imagery to Create 3d Models of Greater Sage-grouse Habitat Ryan Howell	
	Female Yearling Mule Deer Dispersal on the South Slope Unit Tabitha Hughes	

	Assessing Mortality Patterns of Cougars Within the Urban-Wildland Interface Daniel A. Johnson	
	Analyzing the Effectiveness and Application of Multiple Monitoring Methods of Wintering Raptors in Cache Valley Daniel Kimball	
	Bambi, How Fat is Your Mother? Sydney Lamb	
	Leporids as Indices of Eagle Populations: Update on a Statewide Initiative Samantha Phillips	
	Black Rosy-finch: Utah Breeding Range Update and Survey Recommendations Terri Pope	
	Project WAfLS: Predicting Responses of Short-eared Owl Population Size, Distribution, and Habitat Use in a Changing Climate Terri Pope, Russell Norvell, and Robert Miller	
	Do Competitive Interactions Influence Mule Deer Selection of Birth Site? Daniel Sallee	
	Monitoring Rare Plant Species and Habitat Use by Ungulates in the Tushar Mountains, Utah Heather Shipp	
6:30 PM	**Awards Banquet (Dinner and Raffle and Awards Oh My!)**	**SpringHill Marriott**

Friday, March 22nd		
8:00 AM	**TWS Registration**	
8:30 AM	**UT TWS Announcements**	**Canyon Community Center**
Session Moderator: Newly-Elected Odd-year Board Member		
8:40 AM	**Rapid Stream-Riparian Assessment: An Effective Method for Monitoring and Assessing Stream Health** Janice H. Gardner	
9:00 AM	**Winter Response of Sagebrush and Sage-grouse to Dixie Harrow Treatments** Jason Wood	
9:20 AM	**Use of Flash Flaming Technology to Improve Seed Handling and Delivery of Winterfat Seeds** Mitch Thacker	
9:40 AM	**Perception Versus Reality: Evaluating the Effectiveness of Bison Migration Deterrent Strategies** Brad Crompton	
10:00 AM	**Break**	
10:20 AM	***UT TWS Chapter Business Meeting*** Daniel Olson	

Session Moderator: Newly-Elected President-Elect		
10:40 AM	**Managing Elk Populations on Utah's Wasatch Mountains Unit: A Lesson in Scale, Passion, Perspective and Being "Right"** Dax Mangus	**Canyon Community Center**
11:00 AM	**North Slope Mule Deer Migration Project** Amy VandeVoort	
11:20 AM	**Effects of Net-gun Capture on Survival of Mule Deer** Madelon Van de Kerk	
11:40 AM	**Winter Ticks and Nutritional Condition as Potential Drivers for Moose Reproductive Success in Utah** Sam Robertson	
12:00 PM	**Meeting Adjourned – See you Next Year!**	

UTTWS 2019 PAPER ABSTRACTS

INSTANTANEOUS SAMPLING AND PHOTOGRAPHIC CAPTURE-RECAPTURE: COMPARING ESTIMATES OF POPULATION SIZE FOR TECHNIQUES USING REMOTE CAMERAS

B.J. Adams[1], Kanalu Sproat[2], Randy T. Larsen[1], Brock R. McMillan[1]
[1]Department of Plant and Wildlife Sciences, Brigham Young University, Provo, UT 84602
[2]Division of Forestry and Wildlife, Department of Land and Natural Resources, Kamuela, HI 96743

Effective management of wildlife benefits from accurate estimates of population size. Remote cameras have become increasingly popular as tools for estimating population size through methods like photographic capture-recapture (CR). For many species, CR is not possible without first capturing and marking animals for recapture. A recently developed technique addresses this limitation by using imagery of unmarked animals to sample population density with replication, otherwise known as instantaneous sampling (IS). However, IS has yet to be compared with a robust method such as CR. Our objective was to estimate the size of an ungulate population using IS, and compare it with estimates derived from CR. In September 2016 we captured 80 feral sheep (*Ovis musimon* and *Ovis aries*) on the island of Hawai'i and marked them with ear tags for photographic recapture. During the summers of 2017 and 2018 we deployed remote cameras in randomly generated locations to detect sheep. We programmed cameras to trigger every 15 minutes regardless of whether animals were present. Images taken in this manner acted as samples of population density within the camera's field of view. We also programmed cameras with infrared and motion detection during 2017 to build encounter histories of marked sheep for CR. Through IS we estimated the population size to be 850 individuals, 95% CI [715, 984] in 2017, and 934 individuals, 95% CI [771, 1091] in 2018. Through CR we estimated population size to be 919 individuals, 95% CI [544, 1552] in 2017.We observed that estimates of population size derived from IS and CR were similar, and that the confidence intervals of IS were smaller than those of CR. Our results provide support for IS as an alternative method of estimating population size when compared to CR.

IMPACT OF MULTIPLE BIOLOGICAL AND ECOLOGICAL FACTORS ON THE SURVIVAL OF TRANSLOCATED CHUKARS IN NORTHWESTERN UTAH

R. Justin Bingham[1], Randy T. Larsen[1], Frank P. Howe[2], and Jason D. Robinson[3]
[1]Department of Plant and Wildlife Sciences, Brigham Young University, Provo, UT 84602-5253
[2]Utah Division of Wildlife Resources University Research Liaison, Department of Wildland Resources, Utah State University, Logan, Utah, 84322-5230
[3]Utah Division of Wildlife Resources, 1594 W North Temple, Salt Lake City, UT 84116

Translocation is commonly used in wildlife conservation and management as a surrogate for natural dispersal and colonization. Effective translocations of wildlife are documented in the literature, but many liberations end in failure. Chukars (*Alectoris chukar*) are upland gamebirds that have been widely introduced for hunting, but specific factors influencing their post-release survival are poorly understood. We evaluated differences in survival of translocated chukars by releasing 573 and 249 radio-marked pen-reared and wild-trapped individuals, respectively, from 2010-2014. Wild-trapped birds were released either at their trap site (resident) or into novel environments (translocated), whereas pen-reared indivduals were purchased from two local game farms and released into wildland habitats. We analyzed the effects of multiple biological and ecological variables on survival of wild and pen-raised chukars. We used a model selection framework employing known fate models and model averaging in Program Mark to estimate survival. For wild birds, the two best models were: Year + Release Site + Age + time (survival varied monthly) + either Mass, Sex, and Water Availability or Mass and Water Availability. Regarding group variables, Release Site had the biggest effect on survival, followed by Age and Year. The descending order of importance for individual covariates was: Mass, Water, Sex, Group Size and Trap Site. For pen-raised chukars, the two competing models were: Release Season * Release Site * Mixing with Wild Birds + time (survival varied monthly) + either Mass or Age and Mass. For group variables, Mixing with Wild Birds had the biggest impact on survival, followed by Release Season, Supplier, Release Site, and Year. The influence of individual covariates varied in descending order as: Mass, Age, Sex, and Group Size. The ability to reach desired goals for wildlife management and conservation through translocations will hinge on understanding and applying release techniques that augment survival.

FIVE IMPORTANT CONSIDERATIONS FOR SAGE-GROUSE TRANSLOCATIONS: A CASE STUDY FROM UTAH'S WEST DESERT

Melissa S. Chelak and Terry A. Messmer
Department of Wildland Resources, Utah State University, Logan, UT 84322

Translocations have been utilized as a tool to establish and augment populations. A study published in 1989 reviewed the translocation literature and found that 90% of translocations were comprised of game species, and 43% of those were gallinaceous birds (Griffith et al 1989)). This makes them a primary candidate for successful translocations. Sage-grouse translocations began in the early 1930's and became increasingly popular as concern for the species escalated in the late 20th century. Across the species' range, there have been translocations performed in 10 states and 2 provinces. Of those states, Utah has been one of the only states to foster most translocations; this could be due to its isolated islands of sagebrush that act as geographical barriers for the translocated individuals to leave. There have been 5 translocations performed in Utah, with two attempting to augment Gunnison sage-grouse (*Centrocercus minimus*) populations in the 1970's and late 1980's. Utah's translocations performed in Strawberry Sage-grouse Management Area (SGMA) informed and improved translocation protocols. Since then, there have been translocation into the Anthro Mountain population and the Sheeprock SGMA population. The Sheeprock SGMA translocations began in 2016, after a long period of decline from 2006. In our presentation, we outline the importance of protocols, incorporating genetics, understanding habitat and habitat selection, monitoring movements and vital rates, and incorporating an adaptive management approach using preliminary data gathered from the Sheeprock translocations.

PERCEPTION VERSUS REALITY: EVALUATING THE EFFECTIVENESS OF BISON MIGRATION DETERRENT STRATEGIES

Brad J. Crompton
Utah Division of Wildlife Resources, Southeast Region, Price, UT 84501

It is estimated that nearly 60 million bison (*Bison bison*) once roamed across most of North America prior to dramatic declines due to widespread commercial hunting and other factors. Today, wild free roaming populations of bison are found on several mountain ranges in Utah. Bison are known to be nomadic grazers. Today, the nomadic nature of bison herds create unique challenges for wildlife managers. Bison often migrate across administrative boundaries. The Uintah and Ouray Indian Reservation Hill Creek Extension consists of over 500,000 acres in Uintah and Grand counties in eastern Utah. The Ute Tribe manages a large herd of wild bison there. In recent years, hundreds of bison have begun migrating off of Reservation lands to adjacent public lands west of the Green River. Private landowners and public land grazers in this area have concerns over the potential for disease transmission from bison to cattle as well as the competition for forage and have demanded that bison be removed from these lands. This area is extremely remote with little to no road access most of the year. Several strategies were developed to deter bison migration to this area. These included; helicopter hazing, a limited hunting season, and fencing primary migration routes. GPS transmitters were placed on 11 cow bison from 2016 to 2019. We monitored their response to each of the hazing techniques. We found movement distances back to Reservation Lands were greatest after helicopter hazing but bison would often return within several weeks. Hunting increased daily movement patterns of bison substantially but rarely caused long distance migrations. Fencing did little to deter bison migration as bison found ways around or through fences in a matter of a few days. Long term strategies are needed and should include increased population control measures on Ute Tribal lands, habitat projects to improve winter range on Tribal lands, educating livestock operators regarding disease transmission risks, and improved coordination and cooperation between state, federal, and tribal agencies.

WASATCH WILDLIFE WATCH: UNDERSTANDING THE ECOLOGICAL RELATIONSHIPS BETWEEN COUGARS (*PUMA CONCOLOR*), THEIR PREY, AND HUMANS ALONG TWO WILDLAND-URBAN INTERFACES

Natalie D'Souza[1], Timothy Cromwell[1], Lauren Newton[2], Katie Christensen[2], Jordan Calwell[2], Austin Green[2], Mary Pendergast[3], Çağan H. Şekercioğlu[2,4], Daniel R. MacNulty[1]
[1]Department of Wildland Resources, Utah State University, Logan, UT 84321
[2]School of Biological Sciences, University of Utah, Salt Lake City, UT 84112
[3] Wild Utah Project, Salt Lake City, UT 84101
[4]College of Sciences, Koc University, Rumelifeneri, Istanbul, Sariyer, Turkey

The Wasatch Mountains contribute to Utah ranking tenth amongst states in biodiversity and fifth in species endemism. However, the Wasatch Mountains also contain some of the most highly recreated National Forests in the country, receiving more than nine million visitors every year (equal to all five of Utah's National Parks combined), and form one of the most well-defined wildland-urban interfaces in the western U.S. Consequently, Utah ranks fifth in the nation in proportion of species at risk of extinction. As Utah's population continues to increase at one of the fastest rates in the country, these anthropogenic pressures on wildlife in the Wasatch are expected to increase, potentially leading to a rise in human-wildlife conflict. As part of Wasatch Wildlife Watch – a large-scale, community science camera-trapping collaboration between the University of Utah, The Wild Utah Project, The Natural History Museum of Utah, Utah's Hogle Zoo, local and federal wildlife and wildland agencies, and over 300 community volunteers – the Utah State University Cougar Project has established 48 camera stations positioned at a density of one camera per 0.5 km^2 across three major canyons of the northern Wasatch Mountains in the Bear River Range. This project looks to gather fine-scale data on how humans, prey, and environmental factors relate to cougar spatial

ecology. Cougar are naturally susceptible to human activity and habitat fragmentation as they exist in low individual numbers, require large tracts of intact habitat to find prey, and have large home ranges that can potentially overlap with wildland-urban interface designation. Understanding not only how cougar ecology relates to human activity, but also the ecology of their prey, can help wildlife managers understand the potential effects of increases in human traffic in Utah's remaining wildlands.

RAPID STREAM-RIPARIAN ASSESSMENT: AN EFFECTIVE METHOD FOR MONITORING AND ASSESSING STREAM HEALTH

Janice H. Gardner[1]
[1]Wild Utah Project, Salt Lake City, UT 84101

Stream and riparian systems are some of the most important and limited habitats in Utah. Over use and improper land management has degraded stream and riparian systems in the western United States. Restoration of these degraded systems is a priority for many land managers and conservationists. Low-tech stream restoration tools, such as beaver dam analogues, have become popular because they are cost effective. However, there has been a call across stakeholder groups for more data and monitoring on their effectiveness. Given the limited funding and resources for restoration projects, it is beneficial for monitoring programs to be appropriately scaled to the restoration effort. Since 2007, Wild Utah Project and our agency and non-profit partners have been using the Rapid Stream-Riparian Assessment method to efficiently assess the condition of a stream. The Rapid Stream-Riparian Assessment utilizes qualitative and quantitative data collected in a stream to generate a score for water quality, hydrogeomorpohology, fish and aquatic habitat, riparian vegetation, and terrestrial wildlife habitat. The Rapid Stream-Riparian Assessment provides a time and cost efficient means for land managers and conservationists to determine the overall health of a stream and monitor the results of restoration projects.

REMOTE CAMERA SURVEYS TO INVENTORY AND MONITOR WILDLIFE IN CEDAR BREAKS NATIONAL MONUMENT

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Cedar Breaks National Monument, located in Utah, is host to numerous types of vegetation in varying climates. Forests, meadows and unique 'redrock' habitats created by the Claron sandstone formations of southern Utah provide rich wildlife resources. Our project to monitor and inventory wildlife in the monument in 2018 is the most recent survey of the area since 2002. Our project used two remote camera survey methods. In addition to the traditional method of placing camera to capture large mammals, we developed a method to detect small mammals. Motion-sensor remote cameras were set at ground level approximately 1/2 meter from a 1/3m -long corrugated plastic tube. With this combined methodology, over twenty unique mammalian species have been identified in the National Monument- including seven species that were previously unseen and unconfirmed in the monument. The small mammal detection method was equally as effective as the traditional (large-mammal) method in detecting large and medium mammalian species while being more effective in detecting small mammalian species. We conclude that this new remote camera survey method is an effective way to survey mammalian species of all sizes for an area's richness.

INFLUENCE OF PREWINTER NUTRITIONAL CONDITION AND AGE ON RATES AND CAUSE OF MORTALITY OF MULE DEER

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Determinations of compensatory and additive mortality have considerable implications for directing management of a population. Although some advances have been made in determining the influence of these processes, little progress has been made regarding a quantitative approach to characterize compensatory and additive mortality for large ungulates. For this study, we examined the relationship between nutritional condition and cause-specific mortality for mule deer on 11 Wildlife Management Units located throughout Utah. From December 2014 to December 2018, UDWR captured 1252 adult mule deer and 716 6-month old fawns. We fitted all deer with satellite GPS collars equipped with a 12-hour mortality censor and attempted to locate all mortalities within 48 hours of being notified of a mortality to assign the most probable cause of death. From December 2014 to February 2019, we investigated 768 deer mortalities. Preliminary results indicate that ingesta-free body fat (IFBF) of adult mule deer killed by coyotes was not different from those dying of malnutrition. In contrast, mountain lions killed deer that have IFBF estimates representative of what is available in the population. When examining mortalities in relation to deer age, coyotes primarily killed fawns and older adults ($\geq$ 8 years old), whereas cougars killed deer across all age categories in proportion to availability with some avoidance of fawns. These results suggest that coyotes are killing deer in relatively poor condition with an increased risk of dying from other causes. As such, mortalities caused by coyote predation have a greater likelihood of being compensatory. Conversely, mountain lions are killing deer in better condition with higher odds of survival indicating the potential for a more additive effect.

SURVIVING THE HUNTS: THREE VERY OLD FEMALE BLACK BEARS FROM UTAH AND MINNESOTA

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In game species, many individuals never reach old age because they are killed by hunters or succumb to accidents, disease, predation, starvation, and the inherent risks of reproduction. One of the best examples of the effects of hunting on longevity is that of black bears in Minnesota; where, from 1974 to 2010, there were only three bears, out of a sample 55,000 hunter-killed tooth-aged bears, who lived to be 30+ years old (Noyce & Garshelis, 2010). In Utah, the oldest known female bear (Xina), captured in 1992 at four, is still alive and turned 31 in January of 2019. She has worn a radio collar for 27 continuous years, during which time she became reproductively active at age four and then reached reproductive senescence at age 24. She had eight litters and 22 cubs. Only one of the first 14 survived to yearling stage; but the remaining eight cubs from three litters survived. To our knowledge, Xina is the oldest black bear whose complete reproductive and non-reproductive history is known from direct observations of winter dens. Her performance stands in stark contrast to two other research bears from Minnesota. One died of natural causes at age 39, producing 26 cubs in 10 litters (88.5% survival); and another, reported by Rogers (pers. com., 2019), who at age 32, had 25 cubs born in 11 litters with no cub mortality through the first 15 to 16 months of life. The old Utah bear lived in a natural landscape, as did the Minnesota bears; however, the 32-year-old had access to supplemental human foods. Habitat quality is known to directly affect reproductive success in black bears. From these data, we

conclude that the habitat in Minnesota is more favorable to cub survival than the habitat on the Book Cliffs in Utah. The Book Cliffs can be poor habitat (at best) in given years and may account for the high cub mortality (59%) reported by Black and Auger, 2004. How these bears lived to such old age is probably best explained by a multitude of factors including luck, continuous wearing of radio collars, presence of accompanying offspring, avoidance of human activity, and nocturnal behavior during the hunting season. These three old females spent their entire lives in hunting units—a combined 103 years of bear hunts—which makes their stories even more unusual.

MODELING CARNIVORE INTERACTIONS IN NORTHEASTERN OREGON USING ACTIVITY AND OCCUPANCY PATTERNS

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In multi-carnivore systems, species exhibit significant interactions (e.g. intraguild predation) or successfully avoid each other in space and time. This study examines interactions between cougars (*Puma concolor*), bobcats (*Lynx rufus*), and coyotes (*Canis latrans*) in the Starkey Experimental Forest and Mount Emily, Oregon during 2016 and 2017. Coyotes and bobcats are considered dietary generalists and have comparable home range sizes, which suggests some niche overlap. Cougars have been known to kill both coyotes and bobcats, indicating possible effects through intraguild predation. Our objective is to assess the degree of interspecific competition based on species-specific camera trap detection rates, while accounting for habitat covariates that may signify preferences for certain areas rather than species avoidance. Researching potential competition between these sympatric carnivores and their spatial and temporal land use is important to more fully understand how carnivores are distributed on a landscape.

MANAGING ELK POPULATIONS ON UTAH'S WASATCH MOUNTAINS UNIT: A LESSON IN SCALE, PASSION, PERSPECTIVE AND BEING "RIGHT"

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In 2013 the Utah Division of Wildlife Resources (UDWR) conducted aerial surveys for elk (*Cervus canadensis*) on the Wasatch Mountains management unit. Biologists counted far more animals than anticipated and substantially more animals than the population objective specified in the unit management plan. The UDWR has a legal obligation to manage to the population objectives in approved management plans. In response, UDWR implemented aggressive antlerless elk harvest strategies to reduce the population. Shortly after implementing the new harvest strategies, wildlife managers began to face fierce opposition to the changes along with mounting social and political pressures. The UDWR and elk advocates both had compelling "data" which was used to bolster their respective positions. The credibility of the UDWR was called into question, the UDWR dismissed the claims of sportsmen and both parties dug in their heels until a pivotal moment changed the discussion. Wildlife elicit strong emotions in people. Often, the scale at which the public or sportsmen experiences wildlife is much different than the scale at which that wildlife is managed. Reconciling differences in scale took effort on both sides, but looking at the issue from other perspectives opened the door to productive dialog. Ultimately, through cooperation, humility and willingness to look at issues from other perspectives all parties were able to find common ground and work towards effective solutions. Participants discovered that there are lots of "right" ways to manage wildlife. Lessons learned through this process led to strong partnerships and significant changes to both unit and statewide elk management plans, changes that were approved with overwhelming support from diverse constituencies.

IMBCR BIRD MONITORING – APPLICATIONS FOR MILITARY INSTALLATION

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The Integrated Monitoring in Bird Conservation Regions (IMBCR) program started in Colorado in 2008 and has grown in the last ten years to become one of the largest bird monitoring programs in the United States spanning over 13 states and dozens of partners. IMBCR surveys are used to gather data on bird populations and habitat and provide density and occupancy estimates for landbird species. Utah joined the partnership in 2015, and subsequently Dugway Proving Ground (DPG) and Hill Air Force Base (HAFB) also joined the effort. Survey strata were selected on DPG and HAFB to specifically encompass areas of military impact with the goal of establishing baseline population estimates, comparing estimates between strata with different land uses, and estimating and monitoring trends in population densities and occupancies. We hope to use these data to identify changes in density and occupancy at the species and overall community levels and guide future management decisions.

THE UTAH WILDLIFE MIGRATION INITIATIVE: MANAGING REAL-TIME MOVEMENT DATA

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The Utah Wildlife Migration Initiative is documenting, preserving, and enhancing wildlife movement. The Initiative uses GPS tracking technology to monitor the movements of over 2,000 animals throughout the state. As part of the Migration Initiative, the Utah Division of Wildlife Resources has developed a state-of-the-art system to effectively track large numbers of animals at vast spatial scales. This presentation will discuss how we have automated the flow of movement data from the animal tracking collar to web apps that make the data readily useable. Movement data is being used to define critical habitats for species, including migration corridors that provide essential linkages between seasonal ranges. Other products generated by the Initiative include maps of stopover sites, bottlenecks, movement barriers, and the identification of mitigation needs such as wildlife crossings that safely move species under or over busy highways.

WINTER TICKS AND NUTRITIONAL CONDITION AS POTENTIAL DRIVERS FOR MOOSE REPRODUCTIVE SUCCESS IN UTAH

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Reproductive success in all species is an important component for being able to grow and sustain a healthy population. In most ungulates it is driven by age structure and nutritional condition of the females. As part of the Utah moose *(Alces alces*) research project we focused on nutritional condition and winter tick (*Dermacentor albipictus*) loads on two different moose units as possible drivers impacting female moose reproductive success. In 2017, 2018 and 2019, 81 adult female moose were captured or recaptured on the North Slope and 83 on the Wasatch. During these captures' ultrasonography was used to assess nutritional condition by measuring rump fat and loin thickness. Tick counts were conducted via transects along the shoulder and rump. It has been found that the more rump fat a female moose has the higher probability she has of becoming pregnant, parturition and recruiting young into the population. This is true of both the North Slope and Wasatch. In 2017 and 2018 the pregnancy rates (43% and 63%) for the North Slope were very close to the calving rates (41% and 55%). However, on the Wasatch the pregnancy rates in 2017 and 2018 were 90% and 95% while calving rates were 61% and 65% a reduction of almost 30% for both

years. The number of Winter ticks per moose is significantly higher on the Wasatch and increased winter tick abundance can lead to reduced reproductive success in female moose by depleting their body's resources near the time of parturition. Logistic regression models show that rump fat is the most important driver for a cow moose to produce a calf on the north slope meanwhile on the Wasatch rump fat is important but not as significant as ticks per 10cm transect. Thus, the probability of a cow having a calf goes down as tick abundance goes up on the Wasatch.

CONSERVATION IN THE 21ST CENTURY: THE BALANCING ACT BETWEEN SCIENCE, POLITICS, AND THE LAW

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Often times, as wildlife biologists or land managers, we assume that scientific data and understanding is the primary driver of decision making and management actions. However, frequently, socio-political and legal constraints may be significant factors that guide the outcomes in wildlife and land management decisions at both a state and federal level. As Utah continues to grow, and as tolerance for certain species of wildlife varies across jurisdictions, landscapes, and constituencies, land and wildlife managers have become more aware of the socio-political and legal implications of species management. The science, laws and policies guiding species management, including species such as wild horses (Equus ferus), sage-grouse (Centrocercus urophasianus), and bighorn sheep (Ovis canadensis), among others, has become an ongoing challenge to land and wildlife managers throughout the west. A prime example of the species-management challenge arose during 2018 while Utah developed statewide management plans for bighorn sheep and mountain goats (Oreamnos americanus). Though biologists and researchers for the State have spent decades studying bighorns and mountain goats in Utah, legal challenges and social and political tolerance for management of these large ungulates became an openly divisive issue during 2018, prior to, and during the development of, Utah's management plans for those species. Some of the major legal, political and scientific issues managers grappled with included: disease-transmission between bighorn and domestic sheep, Endangered Species Act considerations, social tolerance for hunting, and federal land management policies and litigation surrounding those policies, just to name a few. Based on the outcomes of the 2018 management planning efforts for bighorn sheep and mountain goats, we will demonstrate that collaborative, "evidence-informed" stakeholder engagement is the foundation for navigating the ongoing complexities of species conservation in Utah and throughout the West. We will also discuss lessons learned for productively engaging stakeholders, defining roles and responsibilities of individuals, facilitating teamwork and establishing an environment of trust that leads to responsible and sustained decision making and species management.

HAWKWATCH STUDIES OF URBAN RAPTOR ECOLOGY, WITH AN EMPHASIS ON THE AMERICAN KESTREL

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HawkWatch International is working with citizen scientists to conduct various activities under the umbrella of our Studies of Urban Raptor Ecology ("SURE") program. The SURE program began with our monitoring of nesting American kestrels (*Falco sparverius*) in the greater Salt Lake City (SLC) metropolitan area in 2014. Since this time, 40-60 citizen scientists have monitored a network of 200–400 nest boxes annually, distributed in different landscapes within an area home to over 1.2 million people. We document clutch size, brood size, and number of fledglings produced by kestrels in wildland, agricultural, and urban landscapes. From 2014–2018, we monitored 421 nesting attempts and found no difference in nest success (fledging ≥ 1) between nests in differing landscapes, although nest success in wildland landscapes appeared more stable than that of nests in agricultural or urban areas. Kestrels nesting in urban landscapes had slightly smaller clutches than their counterparts in agriculture or wildlands. We also band and color band nestling and adult kestrels in an effort to monitor movement, and eventually estimate survival in different landscapes. To date we have banded 1,475 kestrels in our study area, and color banded 634 of these birds.

This winter (January 2019) we launched an urban raptor community survey using a grid-based sampling design that will be repeated 4 times per year to describe seasonal raptor populations across rural to urban gradients. In 2019 we will expand nesting surveys and color banding to Cooper's Hawks (*Accipiter cooperii*), Red-tailed Hawks (*Buteo jamaicensis*), and Golden Eagles (*Aquila chrysaetos*) in and around SLC. Feather and blood sampling is planned to investigate contaminant levels in these raptors. Our SURE research activities will provide the public with up-close and hands-on opportunities to engage with raptors, provide insights into raptor health in our shared environments, and help us identify landscape designs that will allow humans to realize the full benefits of the ecosystem services raptors provide.

MONITORING NATURAL RESOURCES IN THE SPACE AGE: APPLICATIONS OF SATELLITE IMAGERY FOR WILDLIFE MANAGEMENT IN THE MOUNTAIN WEST

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The Mountain West is characterized by tremendous climatic, botanical, and anthropogenic variation, all of which makes natural resource management difficult. Wildlife managers are charged with conserving populations of large, mobile animals in seasonal and dynamic environments defined by mixed land-uses and multiple ownership patterns. Human demands for water, recreation, and industrial applications on these lands are growing, making management of wildlife more complex and expensive. Here we discuss the utility of using remotely sensed imagery for monitoring and management of wildlife habitats in Utah and other rapidly growing states. Using examples developed for several species of concern, we argue that the environmental phenomena driving animal distribution, habitat-use, survival, and migration can be monitored and mapped for decision making related to habitat conservation and restoring connectivity. We highlight examples related to estimating forage abundance and phenology to predict sage grouse and mule deer reproductive schedules, drought monitoring for free-ranging livestock, predicting the distribution and frequency of ephemeral water resources to identify cattle-horse conflicts, and mapping critical snowpack contours to classify migration routes and critical winter ranges for sage grouse, mule deer, and elk. We argue that tradeoffs related to field-scale measurements are compensated for by the synoptic and temporal depth afforded by satellite imagery. Moreover, its proven utility for monitoring dynamic resources and mapping critical life phases and associated habitats for species of concern makes it a valuable decision-making tool for identifying critical habitat patches for conservation or restoration.

USE OF FLASH FLAMING TECHNOLOGY TO IMPROVE SEED HANDLING AND DELIVERY OF WINTERFAT SEEDS

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Ecological restoration of rangelands using wild-collected seeds can be difficult due to low seed quality, inconvenient seed anatomy, and poor plant establishment. In rangelands of North America, the half-shrub winterfat (Krascheninnikovia lanata) is a valuable protein rich forage for wildlife and livestock, particularly during the fall and winter period. Seeds are contained in one-seeded fruits enclosed in four silky bracts. While the seeds can be removed from the bracts through cleaning it is not recommended as the bracts are thought to help protect the radicle region of the seed and aid in germination and growth. However, fluffy bracts of winterfat make it difficult to incorporate the seed within a seed mix because it prevents the seed from flowing through mechanized seeders. Our results indicate that flash flaming can remove seed appendages, which reduces the seed volume by up to 44% without impacting

overall germination. Flash flaming allowed for the application of a polymer seed coating. Flash flaming in combination with seed coating allowed the seeds to be precisely delivered through a broadcast seeder and rangeland drill, whereas untreated seed was unable to flow from the seeders at a rate that would meet suggested guidelines for this species. These results indicate that flash flaming now provides a new technology that will allow for the treating and planting of winterfat seeds on degraded rangelands with mechanical seeding equipment.

EFFECTS OF NET-GUN CAPTURE ON SURVIVAL OF MULE DEER

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Remote tracking devices such as radio collars are of great use for wildlife studies, but capture techniques to deploy such devices always risk mortality and injury to the animal. Capture-induced mortality not only affects population sizes, but also introduces bias in survival estimates based on data from captured animals. In recent years, a large-scale research and monitoring project in Utah has involved capturing and radio collaring hundreds of mule deer (*Odocoileus hemionus*), a species of great interest in large parts of North America. Our objective was to investigate how the survival rates of these mule deer were affected by capture and handling to place collars. An experienced capture crew net-gunned 944 animals during the winters of 2014-2018. After being blindfolded and hobbled, the deer were transported to the nearest landing zone in a sling under the helicopter. There, the deer were taken out of the sling, weighed, aged, measured, fitted with a GPS collar and released. We used Cox proportional hazard regression within a model selection framework to compare the survival rates of animals that were captured in a particular year to those of animals that were not captured but fitted with a GPS collar in a previous year. Overall annual survival rates were 71% and 78% for captured and non-captured animals, respectively. The top survival model had a model weight of 0.8 and included an interactive effect of age and capture, with the negative effect of capture increasing with age. This model predicted similar survival rates of 80% for 2.5 year old animals that were and were not captured, but survival rates were 68% and 77% for 5.5 year olds that were and were not captured, respectively. We recommend caution with analyzing GPS data from recently captured animals, as demographic rates may be biased compared to the overall population.

NORTH SLOPE MULE DEER MIGRATION PROJECT

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Mule deer (*Odocoileus hemionus*) often use different summer, winter, and migratory habitat. Advances in radio collar technology now allows for easier and more efficient migration studies to determine migration corridors, survival during migration, and differences between males and females in timing of migration and habitat selection. The Utah Division of Wildlife Resources started this project to better understand migration routes on the North Slope of the Uinta Mountains to aid in habitat management practices and mule deer management between states and within state. Five mule deer bucks and 12 does were radio collared during the summer of 2018 on their summer range. Various capture techniques were tried, including drop net, clover traps, and dart gun immobilization. An additional 60 mule deer were radio collared in early December with a helicopter and net gun in Utah and Wyoming in areas that are believed to be winter areas for North Slope mule deer. Mule deer collared during the summer showed mostly south and easterly migration routes, which corresponds to data from Wyoming mule deer collared near Mountain View that showed easterly winter migrations towards Flaming Gorge Reservoir. Radio collars will be monitored to determine migration corridors and any differences between bucks and does. Data from this study will greatly aid in habitat management and future Forest Service management plans.

SAGE-GROUSE MOVEMENTS IN A GRAZING LANDSCAPE

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The role of livestock grazing in managing wildlife and their habitats on western rangelands has been long-debated by public land stakeholders, local communities, landowners, livestock producers, and wildlife managers. The controversial nature of this debate stems from limited, and often conflicting data regarding the effect grazing has on habitat vegetation structure or wildlife communities. At the core of this debate is the greater sage-grouse (*Centrocercus urophasianus*; sage-grouse), a keystone sagebrush (*Artemisia* spp.) obligate species, that experienced population declines primarily attributed to habitat loss and degradation. Although range wide conservation efforts have proven successful in stabilizing local populations, the fact the over 80% of the range is grazed by domestic livestock may provide the greatest opportunity to develop a rangeland management strategy that address multiple-use goals. In Utah, research demonstrated that sage-grouse under a high-intensity low-frequency (HILF) rest and deferred-rotation grazing system had higher nest success than sage-grouse inhabiting areas managed under traditional, season-long grazing practices. Ongoing research from Utah State University suggests that strategic grazing may also promote and extend the peak growing season to the benefit of sage-grouse. Additionally, research in Montana has suggested that the timing of livestock grazing may affect arthropod communities important for sage-grouse chicks. Cumulatively, these observations suggest that sage-grouse may benefit from prescribed livestock grazing. We will be evaluating the effects of prescribed livestock grazing on sage-grouse movement and brood survival using long-term datasets for sage-grouse in Rich County, Utah. To complete this evaluation, we will calculate the normalized difference vegetation index (NDVI)—acquired from satellite imagery to analyze the vegetation greenness on a scale for pastures as they are grazed with a deferred-rotation grazing system. We will then overlay sage-grouse brood movements and survival rates on this index of green vegetation to determine if sage-grouse are capitalizing on regrowth stimulated by cattle grazing.

WINTER RESPONSE OF SAGEBRUSH AND SAGE-GROUSE TO DIXIE HARROW TREATMENTS

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Sagebrush (*Artemisia* spp.) is an important source of food and cover for many animals, especially during winter months. Understanding how wildlife species respond to sagebrush management actions can help improve conservation planning. Dixie harrow is a method of improving spring/summer habitat for many herbivores by reducing sagebrush cover to increase the growth of grasses and forbs. These treatments, however, may influence the quantity and quality of sagebrush available to greater sage-grouse (*Centrocercus urophasianus*; hereafter, sage-grouse) during winter. We evaluated the effects of Dixie harrow on the nutritional value of sagebrush, and on sage-grouse resource selection during winter. We were unsure what effect Dixie harrow would have on the nutritional value of sagebrush, but hypothesized that sage-grouse would select for untreated areas because they contained a higher quantity of food and cover. We captured 81 sage-grouse and fit them with GPS transmitters. Using 6,728 winter locations (November – March) we modeled third-order resource selection. Further, we collected samples of sagebrush plants that sage-grouse had eaten from (n = 54), and passed by but not eaten from (n = 54); as well as from random locations inside Dixie harrow treatments (n = 60), and outside Dixie harrow treatments (n = 60). Contrary to our hypothesis, sage-grouse selected for Dixie harrow treatments during winter. We found that sage-grouse selected which sagebrush plants to eat from according to differences in their nutritional value, and that sage-grouse ate from

plants inside treatments more frequently than outside treatments, but Dixie harrow treatments had no effect on the nutritional value of sagebrush. Based on our results, Dixie harrow treatments performed at the southern extent of the sage-grouse range will create habitat that sage-grouse prefer during winter, but it remains unclear why sage-grouse select for Dixie harrow treatments during winter.

UTTWS 2019 POSTER ABSTRACTS

USING DRONES TO IMPROVE EFFICIENCY OF WATERFOWL SURVEYS AT PARIETTE WETLAND IN NORTHEASTERN UTAH

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Monitoring waterfowl populations is an important component of wetland management, but surveys can be time consuming and impacted by observer bias. Unmanned aerial vehicles (UAV), also known as drones, are a new potential tool that may improve efficiency and accuracy of waterfowl surveys in important wetland habitats. One of these important areas is the Pariette Wetlands, located in northeastern Utah, which were developed in 1972 to increase waterfowl production and provide seasonal habitat for many other species. It is the largest wetland development in Utah managed by the Bureau of Land Management. Surrounded by a harsh desert climate, 2,529 of the 9,033 acres are designated as wetland or riparian habitat. In this wetland system, we are developing a UAV-based waterfowl survey protocol to accurately and efficiently conduct waterfowl population surveys. We are using a commercial grade drone (DJI Matrice 210) and a high end camera attachment (Zenmuse X4S) to produce high quality images of the individual ponds in the Pariette Wetlands. Using the program DJIFlightPlanner and autonomous flight app Litchi, we have designed several pre-planned photogrammetric aerial survey transects to understand the impact of the UAV on waterfowl behavior, and to estimate survey accuracy. Our initial protocols will test if UAV presence changes waterfowl behavior based on different approaches/altitudes of flight. To do this we have created flight plans at different altitudes, (20-100 meters, increasing by increments of 10 meters) measuring decibels and potential waterfowl disturbance. Our survey method collects adjacent but non-overlapping photos of all open water habitat present at the Pariette Wetlands. From this large dataset of photos we will systematically sample individual photos to identify and count waterfowl species. As we prepare for the spring migration season, we will be testing our protocols to determine what species can be accurately identified using our developed technique, thus contributing to this evolving protocol and improving survey efforts for the years that follow.

AN INVENTORY AND ASSESSMENT OF NATURAL SPRINGS IN UTAH'S GREAT BASIN: FACTORS ASSOCIATED WITH WILDLIFE DIVERSITY

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Availability of water influences ecological patterns and processes in arid environments. Riparian systems are among the most productive and biodiverse areas in arid regions, and are essential for many plant and animal species to complete their life cycles. Consequently, degradation and loss of natural water features, such as natural springs, can be a major threat to many species in desert ecosystems. Given the ecological role of water, it is necessary that land managers have accurate information on the condition of riparian areas – particularly in arid environments. Our objective is to determine how wildlife diversity is related to parameters associated with condition at approximately 100 natural springs in the Great Basin Desert of Utah. We will determine spring type, measure spring area, and identify microhabitats found at each location. Water presence will be recorded, flow will be measured in L/sec, and water quality will be tested by measuring pH, salinity, conductivity and temperature. Livestock usage will be documented, as well as human alteration such as spring boxes and water diversions. Diversity, richness and evenness of plant and wildlife communities will be assessed using sampling from our survey, as well as photos taken from

motion-sensing cameras. We will then analyze wildlife diversity as a function of landscape and spring attributes. We predict that springs in relatively poor condition will have lower diversity of wildlife than springs in relatively good condition. Our results will assist in future management of these riparian areas in order to preserve our desert ecosystems.

EVALUATING THE ACCURACY OF ESTIMATING AGE USING PATTERNS IN TOOTH WEAR FOR MULE DEER AND ROCKY MOUNTAIN ELK

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Age of individuals is an intrinsic demographic parameter used in the modeling and management of wildlife. Although, analysis of cementum annuli from the roots of teeth is currently the most accurate method used to age ungulates, the age of live ungulates in the field is usually estimated by examining tooth wear and tooth eruption patterns. State and university biologists in Utah have used this method to age several hundred mule deer (*Odocoileus hemionus*) and Rocky Mountain elk (*Cervus elaphus nelson*) caught on net-gun captures as part of a statewide study. However, there are limitations to aging based on tooth wear as the rate of tooth wear varies among individuals due to factors such as environment, diet, age, and sex. Our objective was to determine the accuracy and precision of estimating age of both mule deer and elk based on tooth wear and tooth eruption patterns. We compared ages estimated by tooth wear (collected at time of capture for incorporation of animals into the study) to actual ages determined from cementum analysis (from teeth collected after mortalities of radio-tracked animals from the study). Both species develop prominent annuli (dark-colored growth rings) during the winter months due to poor nutrition for both sexes and poor body condition of males post-rut. Our preliminary results indicate that ungulate ages estimated from tooth wear pattern were accurate to within one year of cementum age 65% of the time for mule deer and 64.7% of the time for elk. As we continue to process more samples, we will further investigate the precision and accuracy of estimating age from tooth wear and eruption patterns. In addition, we will examine the variance associated between observers and ungulate factors including sex, habitat type, and life stage.

MODELING THE EFFECT OF EXPLOSIVE WEAPONRY TESTING ON GOLDEN EAGLE NEST SITE SELECTION AND REPRODUCTIVE SUCCESS

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Noise disturbance is known to deleteriously affect reproductive success of some birds. The effect of disturbance on golden eagle (*Aquila chrysaetos*) nest site selection and reproductive success has been explored in some contexts. However, the effect of noise disturbance caused by explosive weaponry testing has not yet been explored. There are 19 known golden eagle nesting territories within and surrounding the Utah Testing and Training Range (UTTR) where explosive weaponry is regularly tested within designated target areas. The objective of this research was to model the effect of proximity to target areas on nest site selection and reproductive success. Data for both models was collected in 7 years between 2006 and 2018. Nest site selection was modeled using a resource selection function (RSF) framework. Nesting territories were defined as reproductively successful when at least one offspring fledged. We created a priori candidate models that included indices for topography, prey habitat, intraspecific competition, and disturbance. The top models were chosen based on the Akaike Information Criteria adjusted for small sample size (AICc). Competing models were averaged according to AICc weight. The results of this research may indicate

whether standard spatial buffer zones designed to mitigate the effect of disturbance on golden eagle nest site selection and reproductive success are adequate in the context of explosive weaponry testing.

USING HIGH-RESOLUTION sUAS IMAGERY TO CREATE 3D MODELS OF GREATER SAGE-GROUSE HABITAT

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Greater sage-grouse (Centrocercus urophasianus, hereafter sage-grouse) are dependent on sagebrush (Artemisia tridentata) in all life stages. Habitat use is influenced by sagebrush height and percent cover during nesting, brooding, and winter. Measuring sagebrush is traditionally expensive and time consuming if measured in situ, and limited when using traditional remote sensing methods without ancillary data. Improvements in Small Unmanned Aerial Systems (sUAS) technology have greatly facilitated acquisition of high resolution imagery on western rangelands. The emergence of photogrammetry algorithms to generate 3D point clouds from true color imagery provides potential for more efficiently measuring sage-grouse nesting, brooding, and winter habitat. Our objective is to test the accuracy of using high resolution sUAS imagery and photogrammetry to create a three dimensional model of sage-grouse habitat, comprised of sagebrush, grasses, and forbs. We acquired imagery near Strawberry Reservoir, Utah using a DJI Inspire 2 multi-rotor UAV equipped with an RGB camera, flown at 100, 150, 250, and 390 feet. We mosaicked the imagery and generated a Digital Surface Model (DSM) using Pix4D software. We estimated plant height by subtracting fine scale elevation data calculated from the sUAS imagery from the DSM, then perform an accuracy assessment using on the ground measurements taken at the time of flight. We found that by incorporating high resolution sUAS imagery and 3D sagebrush models we can monitor habitat for greater sage-grouse and other sagebrush obligate species in a more cost and time efficient manner.

FEMALE YEARLING MULE DEER DISPERSAL ON THE SOUTH SLOPE UNIT

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Dispersal refers to movement of animals from a natal home range to an adult breeding range, and can have significant impacts on population size and gene flow. Yearling mule deer (*Odocoileus hemionus*) have been observed dispersing great distances from their natal home ranges, however little is known about how often this behavior occurs. Our objective was to determine the frequency and distance of the dispersal events for female mule deer on the south slope of the Uinta Mountains. In December of 2014-2016, we captured a total of sixty fawns on the South Slope of the Uintas and placed GPS tracking collars on each individual. For each individual, we looked at space use during the month of May when animals were 11 months old to examine natal range. We compared space use in natal range to space use during May of the following year (i.e. adult range). Of the sixty fawns captured, only seventeen survived to two years old (28% survival). Of the surviving deer only four (24%) fully dispersed from their natal ranges, if we define dispersal to include adult ranges that do not overlap with natal ranges. The remaining thirteen deer (76%) had adult ranges that contained or overlapped the natal range. Of the four dispersers, we determined dispersal distance by measuring the distance between the center of the natal range to the center of the adult range. The average dispersal distance was 44.32 ± 20.43 km and ranged from 3.96 km to 101.8 km. We can conclude that the dispersal distance of female yearlings on the South Slope is greatly varied, however there appears to be a greater tendency to stay in or near natal ranges in adulthood.

ASSESSING MORTALITY PATTERNS OF COUGARS WITHIN THE URBAN-WILDLAND INTERFACE

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The cougar (*Puma concolor*) is a large obligate carnivore that is vulnerable to both habitat fragmentation and exploitation. As territorial predators, dispersing individuals often occupy marginal habitats or those impacted by human activity. Using mortality data collected from a cougar population in the Oquirrh Mountains near Salt Lake City, Utah, USA from 1997-2009, we compared 41 individual (24 females, 17 males) cause-specific mortalities among different demographic groups. Within the urban-wildland interface human-caused mortalities affected young dispersing males and senescent females disproportionately, suggesting that inexperienced or inefficient hunters may be utilizing human-influenced landscapes to take advantage of anthropogenic food resources. Thus, we determined most human-caused mortalities to be compensatory. Identifying the impacts of anthropogenic sources of mortality in mixed-use landscapes can help account for population fluctuations in these areas, providing a better understanding of how land-use alteration can impact age structure and composition through changes in animal behavior, habitat selection, and mortality. This understanding can also provide for better conflict management and conservation actions for the species.

ANALYZING THE EFFECTIVENESS AND APPLICATION OF MULTIPLE MONITORING METHODS OF WINTERING RAPTORS IN CACHE VALLEY

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Raptor species are top predators and can be used as indicators for measuring habitat quality. Monitoring raptor populations in areas with changing land use can be useful in identifying the effects it has on habitat quality. We compared 3 different methods of surveying winter raptor abundance in Cache County, Utah in order to identify the optimal use for each method. These included annual Christmas Bird Counts, eBird observations, and HawkWatch Winter Raptor Surveys. Christmas Bird Counts are a one-day count that has been conducted for several decades by observers that vary in skill level. We hypothesize that this method will be ideal for detecting rare species as well as targeting specific species. eBird also includes observers that vary in skill level but differs in that it is a collection of daily entries including a larger survey area where rare species are more likely to be reported. We hypothesize that this is a good method for identifying rare species as well as an overall species richness. The HawkWatch surveys are conducted in transects by skilled observes that follow specific protocols. A total of 4 surveys are completed each winter and are conducted during daylight hours. We hypothesize that this method is less likely to detect owl species but is useful for detecting common species and can be used to identify population trends. An ordination analysis helped compared each survey's ability to detect different species and supported many of our original hypotheses. We discovered that Christmas Bird Counts were successful at detecting all but a few species, making it a good method for detecting rare species as well as targeted species. Because of the high volume of checklist submissions to eBird, this method detected all but one species making it a good choice for estimating species richness. There were several species that the HawkWatch method did not detect, however, the highly skilled observers and specific protocols make this method design ideal for identifying population trends.

BAMBI, HOW FAT IS YOUR MOTHER?

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Population growth rates of mule deer (*Odocoileus hemionus*) are driven by many factors including age at first reproduction, sex ratios, reproduction rates, and adult and juvenile survival. While adult females have high and consistent rates of pregnancy and survival, juvenile survival is low and varies dynamically depending on a variety of factors. These factors can include predation, resource availability, climate, and maternal effects. Our goal was to determine factors that influence survival of mule deer fawns in northern Utah. Our specific objectives were to 1) estimate survival and cause-specific mortality of fawns from birth to twelve-months, and 2) assess the influence of maternal condition and habitat selection on fawn survival and growth. We hypothesized that maternal effects are an important predictor of fawn survival. In March 2018 we captured 25 adult female deer, measured body condition, and fitted each individual with a GPS collar and vaginal implant transmitter (VITs). In June 2018, we used the VITs to locate 31 neonate fawns and fit each individual with a mortality-sensing, drop-off radio collar. Using GPS locations from the mother's collars, we located and monitored fawn rearing habitat during June, July, and August. We measured plant cover, composition, and nutritional value. Through the first six-months of life, apparent survival of fawns was 42%. Analyses on maternal condition and habitat are ongoing. This project will provide valuable insight for understanding fawn recruitment and population dynamics of mule deer. We will increase our sample size by capturing 100 additional neonates over the next two summers.

LEPORIDS AS INDICES OF EAGLE PRODUCTIVITY: UPDATE ON A STATEWIDE INITIATIVE

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The black-tailed jackrabbit (Lepus californicus) is a medium-sized leporid of open country shrublands found throughout much of western North America and the Great Basin physiographic regions (Best 1996). The species is an important prey item for coyotes (Canis latrans), golden eagles (Aquila chrysaetos) and other West Desert predators. Research within the West Desert Military Operating Area (MOA) suggests recent declines in golden eagle breeding activity may be related to a decrease in black-tailed jackrabbit abundance within the MOA. In an effort to measure potential jackrabbit declines beyond the MOA, Dugway Proving Ground (DPG) has begun an initiative to survey black-tailed jackrabbit populations across the state of Utah in partnership with state and federal agencies. We used a stratified sampling scheme to select 120 grids across the state of Utah and created 0.4x0.4-km square polygons ("transects") centered within each grid cell. Transects were sampled in May of each year. Observers walked all four sides of the square transect, noting the perpendicular sighting distance of each leporid found. Rabbit density was calculated from sightings using DISTANCE. In 2018, 92 out of 120 transects were claimed for sampling by volunteers (76.6%), a 2.5% decrease from 2017 efforts. Of these, 68 transects were successfully completed and data reported (73%). With continuing long-term data, we will be able to estimate leporid population trends within Utah beyond the MOA. Through monitoring leporid population cycles, we may be able to predict and respond to golden eagle population trends statewide.

BLACK ROSY-FINCH: UTAH BREEDING RANGE UPDATE AND SURVEY RECOMMENDATIONS

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Black Rosy-finch (*Leucosticte atrata*) is one of the least studied North American birds, owing to the inaccessibility and remoteness of its habitat. It breeds along cliffs and in talus in alpine areas of the Intermountain West. Black Rosy-finch has been designated a "species of greatest conservation need" in Utah because of inadequate understanding of its ecology and life history, particularly its breeding distribution. In an effort to update the current knowledge of the Black Rosy-finch breeding distribution, we reviewed the literature, assembled location data from available databases (e.g. Utah Natural Heritage Database, eBird), and conducted informal surveys in potential breeding habitat. Black Rosy-finch has been documented during the June – August breeding season in the La Sal, Raft River, Tushar, Uinta, and Wasatch mountain ranges. Breeding records (i.e. nests, young fledglings) outside of the Wasatch and Unita Mountains are few; but we confirmed previously undocumented breeding activity in the Raft River and La Sal Mountains. We also found strong evidence of Black Rosy-finch presence in the Deep Creek Mountains. Additional surveys need to be conducted to determine if Black Rosy-finches are still present in ranges with historical sightings, and in other ranges with potential breeding habitat where they have not been documented previously. We recommend using a protocol recently developed by Montana Audubon to survey for breeding Black Rosy-finches in ranges with the highest probability of containing breeding habitat, as predicted by a boosted regression tree species distribution model developed by Ed Conrad. These ranges include the Raft River Mountains, Bear River Mountains, Wasatch Mountains south of Mt. Timpanogos, Deep Creek Mountains, Wasatch Plateau, Fish Lake Hightop, La Sal Mountains, Tushar Mountains, Sevier Plateau, Aquarius Plateau, and Markagunt Plateau.

PROJECT WAFLS: PREDICTING RESPONSES OF SHORT-EARED OWL POPULATION SIZE, DISTRIBUTION, AND HABITAT USE IN A CHANGING CLIMATE

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The Short-eared Owl (Asio flammeus) is an open-country species that breeds in the northern United States and Canada, and has likely experienced a long-term, range-wide population decline. However, the cause and magnitude of the decline are not well understood. Following Booms et al. (2014), who proposed six conservation actions for this species, we set forth to address four of these objectives within the Western Asio flammeus Landscape Study (WAfLS) program: 1) better define and protect important habitats; 2) improve population monitoring; 3) better understand owl movements; and 4) develop management plans and tools. Population monitoring of Short-eared Owls is complicated by the fact that the species is an irruptive breeder with low site fidelity, resulting in large shifts in local breeding densities, often tied to fluctuations in prey density. It is therefore critical to implement monitoring at a scale needed to detect regional changes in distribution that likely occur annually. We recruited 622 participants, many of which were citizen-scientist volunteers, to survey at study sites embedded over 87 million ha within the states of California, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming during the 2018 breeding season. We surveyed 368 transects, 331 of which were surveyed twice, and detected Short-eared Owls on 57 transects. We performed multi-scale occupancy modeling and maximum entropy modeling to identify population status, habitat and climate associations. Our estimated occupancy rates suggest an increase in abundance in Idaho and Nevada as compared with 2017, and a continuing decrease in abundance in Utah and Wyoming. These numbers and the newly established estimates in other states will help us to put future changes into perspective. As expected, our occupancy modeling found that the probability of detecting Short-eared Owls was impacted by day of the year, time of the survey and local wind conditions. We most often found Short-eared Owls in stubble agriculture areas with lower levels of grazing.

Cropland at the transect scale was a large predictor in site occupancy. Consistent with recent years our MaxEnt analysis found Short-eared Owls were more likely in areas of shrubland, cropland, and marshland, and grassland. Our results continue to find that Short-eared Owls have a climate association that puts them at great future risk, primarily their apparent preference of landscapes with higher relative precipitation and moderate seasonality. As our summers continue to become drier, as is expected under most climate scenarios, we would expect a further decrease in the population of this species, possibly through the climate's effect on prey abundance. As a result of the consistent implementation of this program within Idaho and Utah, we have established with high confidence that the breeding density of Short-eared Owls in 2018 was lower than 2015 and 2016 within these states, yet has increased in Idaho over levels measured in 2017. Lastly, our results demonstrate the feasibility, efficiency, and effectiveness of utilizing public participation in scientific research (i.e., citizen scientists) to achieve a robust sampling methodology across the broad geography of the western United State. We look forward to the continued implementation of this program in future years.

DO COMPETITIVE INTERACTIONS INFLUENCE MULE DEER SELECTION OF BIRTH-SITE?

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Interspecific competition can influence space use and habitat selection by large ungulates, particularly in multi-species systems. Competitive interactions can reduce access to resources by precluding animals from selecting preferred habitat, thereby altering tradeoffs between nutrition and risk of predation. One period in which animals are particularly sensitive to interactions between nutrition and risk of predation is during parturition. Our objective is to determine the influence of interspecific competition on selection of birth-sites by mule deer (*Odocoileus hemionus*) and subsequent fawn survival. Our study site, the Book Cliffs in eastern Utah, includes a diverse ungulate community comprised of mule deer, elk (*Cervus canadensis*), cattle (*Bos taurus*), and bison (*Bison bison*). In March 2019 and 2020 we will capture adult female mule deer and fit each individual with a GPS collar and vaginal implant transmitter (VITs) to determine habitat use and selection of birth-site. Neonate mule deer will be fitted with mortality sensing radiocollars. We will also fit GPS collars on elk and bison to determine space use, while cattle data will be obtained through fecal surveys. We will create resource selection functions for each species to determine the influence of space use of other ungulates on selection of birth-site and fawn survival by mule deer. We predict that mule deer will select birth-sites with low probability of use from the other ungulate species. The results from our study will provide insight to the ecology and population dynamics of mule deer in a complex and diverse ecological community.

MONITORING RARE PLANT SPECIES AND HABITAT USE BY UNGULATES IN THE TUSHAR MOUNTAINS, UTAH

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Alpine plant communities are of increasing conservation concern. Within the Tushar Mountains of Utah, there are 27 rare, endemic alpine plant species, five of which are classified as high-priority for conservation. Mountain goats (*Oreamnos americanus*) were introduced to the Tushar Mountains in 1986, and the population has since grown to approximately 250 individuals. Controversial claims have been made regarding detrimental ecological effects of introduced goats; however, little scientific data exists to support such claims. Our objectives are to 1) assess population trends for rare plant species by establishing long-term monitoring plots and 2) examine foraging utilization of mountain goats and other ungulates in these alpine plant communities. For each long-term monitoring plot, 50-100 plants were tagged and measured for characteristics, including height, clump diameter, and reproductive output. Plant density and composition of associated plant communities were also determined. Ungulates foraging in alpine

communities included mountains goats, mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*), and cattle (*Bos taurus*). Where ungulates were observed grazing above timberline, transects were established through the center of the foraging area (centroid sampling). Number of ungulates, sex, and age class were recorded for each grazing observation. Centroid sampling consisted of four perpendicular 25-meter transects. Daubenmire frames were placed every 5 meters and plant height, species, cover, and utilization were recorded. Centroid data are currently being analyzed for plant abundances, ungulate foraging preferences, and to assess which plant species are most utilized. This research will help inform managers concerning this controversy and may provide implications regarding conservation and management decisions.