18th Annual
Wildland Resources Department
Graduate Research Symposium

Bashiri Iddy Muzzo

Tate Del Bosco

Rory Eggleston

Liz Siemion

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Friday, April 14, 2023

UtahStateUniversity

18th Annual
WILDLAND RESOURCES DEPARTMENT
GRADUATE RESEARCH SYMPOSIUM

College of Natural Resources
Utah State University
14 April 2023

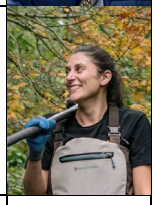
WILDLAND RESOURCES DEPARTMENT

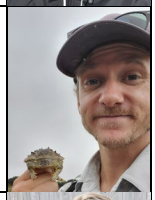
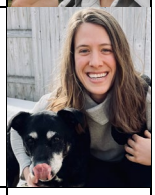
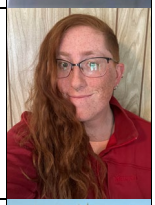
Welcome to the eighteenth Annual Wildland Resources Department Graduate Research Symposium. Today we will have the opportunity to hear from nine M.S. and eleven Ph.D. graduate candidates, as each presents the ideas that will form the basis for their research during their tenure in our Department.

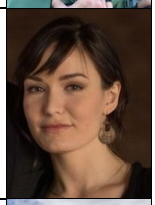
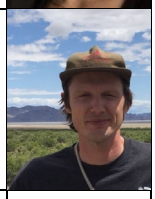
Not all students today will be at the same stage in research development. Many are still thinking about how best to proceed; others have already determined how they wish to address their questions of interest. This diversity of presentations you will hear reflects, in part, the many different approaches each is taking towards answering important natural resource management and conservation issues.

This is their chance to publicly present their ideas, and request your feedback on how to improve their research. Remember, your comments and insights are welcome, and in one sense are expected.

18th Annual
WILDLAND RESOURCES DEPARTMENT
GRADUATE RESEARCH SYMPOSIUM
College of Natural Resources, Utah State University
14 April 2023

Time		
8:20	**Opening Remarks**	
8:30	**WAYMAN, MIKE (M.S. Ecology)** Advisor: R.J. Derose Intra-stand movement of balsam woolly adelgid (BWA) in the Intermountain West	
8:45	**STOKES, BONNIE (M.S. Wildlife Biology)** Advisor: N. Frey The role of coterie family units and predator control in Utah prairie dog translocation	
9:00	**TARAPOREVALA, NEVILLE (M.S. Ecology)** Advisor: J.K. Young Using field methods and citizen science to assess urban canid space use patterns	
9:15	**STOSICH, ALEX (M.S. Ecology)** Advisor: K.E. Veblen Cutting propagation and *in-situ* establishment of white-margined beardtongue (*Penstemon albomarginatus* M.E. Jones), a threatened herbaceous perennial of the Mojave Desert	
9:30	**ALVES, MOLLY (M.S. Wildlife Biology)** Advisor: J.K. Young Evaluating beaver translocation methods to inform establishment success and beaver management policy	
9:45	**Morning Break**	
10:15	**HELCOSKI, RYAN (Ph.D. Ecology)** Advisor: J.T. du Toit The ecological legacy effects of terrestrial megacarcasses: elephant skeletons as islands of fertility	
10:30	**JOHNSON, BRITTANY (M.S. Ecology)** Advisor: K.E. Veblen Predictive modeling of bluebunch wheatgrass (*Pseudoroegneria spicata*) traits using high throughput phenotyping	

10:45	**DEL BOSCO, TATE (Ph.D. Ecology)** Advisor: K. Manlove Examining the effects of press and pulse disturbances on the recovery of an endangered ungulate	
11:00	**MOUALLEM, NADAV (M.S. Ecology)** Advisor: L. Yocom Effects of high severity reburn wildfires on ponderosa pine regeneration and plant community composition	
11:15	**BERGERON, NICHOLAS (M.S. Ecology)** Advisor: D.R. MacNulty Quantifying changes in aspen forest cover in northern Yellowstone National Park after wolf reintroduction	
11:30	**ENGELBERT, LINDSEY (Ph.D. Ecology)** Advisor: J.K. Young Ecological monitoring of mammalian carnivores	
11:45	**Lunch Break** (*on your own*)	
1:00	**MUZZO, BASHIRI IDDY (Ph.D. Range Science)** Advisor: J. Villalba Behavior, welfare, performance and environmental impacts by cattle grazing a grass monoculture and improved with islands of diversity	
1:15	**EGGLESTON, RORY (Ph.D. Wildlife Biology)** Co-Advisors: D. Dahlgren and E. Thacker Habitat use and movement of pinyon jays (*Gymnorhinus cyanocephalus*) in relation to piñon-juniper removal treatments and wildfire recovery	
1:30	**THORPE, TORI (M.S. Ecology)** Co-Advisors: M.W. Chynoweth and J.K. Young Golden eagle predation of greater sage-grouse	
1:45	**SCHIFFER, ANNIE (Ph.D. Ecology)** Advisor: P. Adler Functional traits as a tool for predicting coexistence in heterogeneous landscapes	
2:00	**SIEMION, LIZ (Ph.D. Ecology)** Advisor: K.R. Manlove The mechanistic underpinnings of predation in a multi-prey ecosystem	
2:15	**Afternoon Break**	

2:30	**BERGER, DANIELLE (Ph.D. Ecology)** Advisor: K.R. Manlove Seeing is be-leaving: perception informs migratory decisions in Sierra Nevada bighorn sheep	
2:45	**PARSONS, MITCH (Ph.D. Ecology)** Advisor: J.K. Young Predator-prey interactions between wild pigs and mountain lions	
3:00	**GARRETT, SHANTELL (Ph.D. Ecology)** Advisor: J.T. du Toit Differential effects of grazing by ungulates and lagomorphs in rangeland systems	
3:15	**MALONEY, DUSTIN (Ph.D. Ecology)** Advisor: K.R. Manlove Active sampling of golden eagle nestling diet and associations with habitat across western Utah between 2020 and 2022	
3:30	**Closing Remarks**	

Research Photos

Tori Thorpe

Brittany Johnson

Alex Stosich

Molly Alves

Lindsey Engelbert

Nadav Mouallem

Nick Bergeron

Mitch Parsons and Tuffy

Abstracts

WAYMAN, M.S. Intra-stand movement of balsam woolly adelgid (BWA) in the Intermountain West. M.S. student

Balsam woolly adelgid (BWA, *Adelges piceae* (Ratz.)) is an invasive insect of true firs (*Abies* spp.). BWA spread from initial introductions on the west coast of North America in the 1920s through the Intermountain region and has recently invaded Utah. White fir (*A. concolor*) and subalpine fir (*A. lasiocarpa*) are the two main species of concern in this region; however, subalpine fir has been documented as being more susceptible to attack and subsequent damage. While long-range dispersal mechanisms and patterns are of interest for spread across regions and predicting new infestations, very little is known of how BWA moves within a stand once it is present. I propose to stem-map seven BWA-infested subalpine fir stands and measure BWA intensity on each tree, stand and tree characteristics, and edaphic factors. Individual trees in each stand will be visited three times per growing season for two seasons to detect change in infestation. The rate of tree-to-tree spread is expected to be influenced by stand density, stand age structure, the ratio of non-hosts to hosts and presence of other pests and pathogens. By using spatially explicit stand and tree-level data, we aim to identify tree characteristics that influence new infestations, support current infestations, and predict future infestations. Fine-scale dispersal patterns and associated host structural and compositional conditions will inform our ecological understanding of how sessile insect pests select hosts and disperse in an environment after initial invasion. This knowledge will also inform future management strategies that target stand structural components and tree-level characteristics to more effectively control BWA in the region.

Keywords: Invasive insect; Subalpine fir; Dispersal

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Funding Source(s): U.S. Forest Service Research & Development

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STOKES, B. The role of coterie family units and predator control in Utah prairie dog translocation. M.S. student

The Utah Prairie Dog (*Cynomys parvidens*) is a threatened species belonging to the family Sciuridae. This prairie dog is located in small populations throughout Southwestern Utah. Translocation is a method used in an effort to bolster Utah Prairie Dog distribution and population sizes. Translocation efforts have had varied levels of success due to dispersal, predation, and environmental factors. My study is aimed at increasing the survival rates and longevity of translocated Utah Prairie Dogs. In order to accomplish this goal, we will trap and move prairie dogs as family coterie units to prepared translocation sites Cedar City Bureau of Land Management Field Office lands. Some of the translocation sites will receive predator control efforts to primarily manage native coyote and badger predation. To measure initial survival rates a proportion of translocated prairie dogs at each site will be collared with a VHF radio collar and monitored daily. I hypothesize that by translocating Utah Prairie Dogs as family groups,

while also performing active predator control, will increase initial survival rates and lead to established colonies long term. This study will help direct future Utah Prairie Dog translocation and management efforts.

Keywords: Coterie; Predator Control; Translocation; Utah Prairie Dog

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TARAPOREVALA, N. F. Using field methods and citizen science to assess urban canid space-use patterns. M.S. student

Coyotes (*Canis latrans*) and red foxes (*Vulpes vulpes*) are two charismatic carnivores commonly found in urban areas due to their ability to readily exploit anthropogenic food sources and environments. However, coexistence can be controversial because urban canids pose threats to humans through disease and direct attacks on people and their pets. In order to properly manage human-canid interactions, it is important to understand how wild canids use urban spaces. This typically involves intensive fieldwork, such as the use of GPS collars and camera traps. These data can be important for questions about both population- and individual-level space-use, but are time- and cost-intensive. Citizen science provides a low-cost alternative way to gain information, while simultaneously engaging and educating local residents. Several projects in North American cities have started using sighting reports to build maps of canid-human interactions, but voluntary reporting may have biases as to who and what is reported. We know little about whether these different ways of collecting data provide equivalent information. My thesis will use GPS collars and a camera grid to study space-use of coyotes and red foxes in Wichita, Kansas. Additionally, I will set up a website for community members to report their sightings of canids. I will test how data from reported sightings compares to data collected from GPS collars and camera traps, and to combinations of the three data sets. This study will inform how low-cost citizen science data (sightings websites) can add to or replace data collected from more invasive methods. If comparable, more cities should be encouraged to use citizen science as a useful tool for urban canid data that can inform management.

Keywords: Camera Trap, Coyote, GPS Collar, Red Fox

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Funding sources: Utah State University, Kansas Department of Wildlife and Parks

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STOSICH, A. Cutting propagation and *in-situ* establishment of white-margined beardtongue (*Penstemon albomarginatus* M.E. Jones), a threatened herbaceous perennial of the Mojave Desert. M.S. student

White-margined beardtongue (*Penstemon albomarginatus*) is an edaphic, endemic species threatened by urban development, OHV use, and energy infrastructure in many parts of its range in the eastern Mojave Desert; it is currently being petitioned for listing under the Endangered Species Act. It is an herbaceous perennial plant with a well-

developed taproot that makes salvage efforts of mature plants arduous; additionally, seed set and seed viability are chronically low for this species, making propagation from seed less dependable. Vegetative cuttings for the species may be a reliable and efficient way to obtain plant material for conservation and restoration efforts. However, little is known about the viability of cuttings for this species as well as specific nursery production methods and out-planting factors. In this project, I will collect stem cuttings from populations in Clark County, NV and test different cutting types, hormone applications, pot types, and soil mixes on plant propagation and grow-out in U.S. Geological Survey greenhouse facilities. Established plants will then be out-planted into known habitat and modeled suitable habitat testing different planting timings and planting microsites to determine optimal conditions for out-planting establishment. This work will produce propagation and out-planting guidelines for the species that will help facilitate restoration and mitigation efforts by land managers for the species and for restoration of herbaceous perennials in arid-land ecosystems in general.

Keywords: Arid-Land Restoration; Cutting Propagation; Native Plants

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Funding Sources: Utah State University's Ecology Center, Department of Wildland Resources, and Utah Agricultural Experiment Station; U.S. Geological Survey's Western Ecological Research Center; and Clark County, Nevada's Desert Conservation Program.

ALVES, M. A. Evaluating beaver translocation methods to inform establishment success and beaver management policy. M.S. student

Beavers (American, *Castor canadensis*; Eurasian, *Castor fiber*) have long been valued for their dense fur and aromatic castor, resulting in their near extirpation from North America and Europe in the late 19th century. Their systematic removal led to a loss of wetland habitat and ecosystem services provided by the beaver's damming activity. Modern harvest restrictions have enabled their recovery in some areas; however, there are many barriers to natural recolonization, whether anthropogenic (infrastructure, stream channelization), ecological (climate impacts to seasonal flow and vegetative communities), or political (misclassification and social carrying capacity). Today, beaver translocation has become a popular management strategy for habitat restoration, fire abatement, and a widely accepted method of nature-based restoration in rewilding efforts. There are, however, vast differences in the ways in which beaver translocation programs monitor translocated beavers in terms of release site selection and post-translocation monitoring, how they define translocation success, and the policies that guide translocation activities. My thesis aims to synthesize available information by (1) accumulating and analyzing beaver translocation methodology data from current and past translocations; and (2) developing a database of existing beaver management policies where beaver translocation is occurring. By analyzing the cumulative data from all contributing beaver translocation projects, I propose to create guiding principles for humane and successful beaver translocation. Combining this synthesis, with an accessible database on policies, will allow future translocation projects to rapidly identify best practices for their geographic region.

Keywords: Beaver; Metanalysis; Translocation

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Funding Source(s): Ackerstein Sustainability, Animal Welfare Institute Christine Stevens Award

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HELCOSKI, R. The ecological legacy effects of terrestrial megacarcasses: elephant skeletons as islands of fertility. Ph.D. student

In life, African elephants are significant top-down ecosystem engineers, sculpting the landscape through which they roam. In death, they are a 4,000kg pile of nutrients, from which, a 500kg phosphorus-rich skeleton can persist for >10 years. Over time, these hotspots of soil nutrients may remain in situ, or be dispersed by scavengers and live elephants, thus changing the spatial distribution and the relative intensity of their influence. Existing research in ecological succession and aggregation theory views individual carcasses of much smaller animals as short-lived but significant resource patches, which are capable of influencing plant diversity and nutritional quality. However, no study has followed a carcass out >5 years, or cataloged the breakdown and ecological succession of a megacarcass (>1,000kg). And yet, at any one time, in Kruger National Park (KNP) alone, there may be >3,000 megacarcass-derived nutrient hotspots, at varying stages of decay, causing localized heterogeneity across the landscape, thus fueling a unique patchwork of biodiversity of which we are entirely ignorant. My dissertation research is five-fold, centered around the ecological legacy effects of megacarcasses on terrestrial ecosystems. Objective 1 involves bonefield dynamics, studying megacarcass skeletal dispersal using a line-intercept method to measure the scattering of bones over time in areas of different scavenger and elephant densities. Objective 2 focuses on bone minerals and how their content changes overtime analyzing bonemeal drilled from carcasses 1 to >15 years old. Objective 3 delves into greenhouse tree seedling growth in soil fertilized by a megacarcass as opposed to matrix soil. Objective 4 involves vertebrate visitation of megacarcass sites which I will evaluate using browse surveys, exclosure studies, and scat analysis. Finally, objective 5 looks at broader impacts, and will involve the creation of a grade school level inquiry-based video series and lesson plan that focuses on nutrient cycling.

Keywords: Savanna Ecology, Bonefield, Nutrient Cycling, Megacarcass

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Funding Source(s): National Science Foundation, African Safari Club of Florida

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JOHNSON, B.L. Predictive modeling of bluebunch wheatgrass (*Pseudoroegneria spicata*) traits using high throughput phenotyping. M.S. student

Compositional changes within dryland ecosystems in the Intermountain West region and projected climatic shifts will negatively impact sagebrush-steppe plant communities. Restoration of native perennial bunchgrasses can sustainably increase ecosystem resistance to invasive species like cheatgrass, and resilience to environmental stress and disturbance. Bluebunch wheatgrass (*Pseudoroegneria spicata*) is a native, cool-season, perennial grass commonly used for fire-rehabilitation and other large-scale restoration

projects in the western U.S. Creating and utilizing spatially explicit models of phenotypic traits of bluebunch wheatgrass will establish consistent methods for the evaluation of seedling establishment and plant persistence. These predictive models will aid in selection and development of plant materials used for restoration and assist management practices that decrease the adverse impact of invasive species such as cheatgrass and increase ecosystem services of semiarid rangelands. The research is conducted at experimental sites within Utah and Idaho, which represent different rangeland environments. High throughput phenotyping is done using a UAV (unmanned aerial vehicle) to capture thermal and multispectral imagery at incremental periods throughout the growing season. Images are analyzed for phenotypic traits associated with seedling establishment, weed competition, and plant persistence. Before harvest, in-field measurements for phenotypic traits are collected on a random 10% of the plots. Data mining and exploration will be done to assess relationships between imagery and field data. Those relationships will be used to construct models utilizing machine learning algorithms, then be validated to determine percent error and bias. High throughput phenotyping will improve our understanding of seedling establishment and plant persistence traits, and facilitate selection and development of germplasm used to produce seed needed for fire rehabilitation and other large-scale restoration projects on public and private lands. The re-establishment of native bunchgrasses on public lands could increase vegetative biodiversity within the ecosystem and in turn, create more suitable habitats for ruminants and wildlife.

Keywords: Bluebunch Wheatgrass; High Throughput Phenotyping; *Pseudoroegneria Spicata;* Spatial Modeling; UAV

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Funding Source(s): USDA Agricultural Research Service FRRL

DEL BOSCO, T.D. Examining the effects of press and pulse disturbances on the recovery of an endangered ungulate. Ph.D. Student

Management of endangered species requires balancing threats to recovery that operate on different spatial and temporal scales. Many disturbances can be classified as either 'press' disturbances, which act as a continuous threat, or 'pulse' disturbances, which are acute events. Sierra Nevada bighorn sheep (*Ovis canadensis sierrae;* SNBS) are a federally endangered ungulate found only in the Sierra Nevada mountains of California. Western expansion in the late 20th century led to catastrophic population collapse for SNBS via overhunting, habitat loss, and disease spillover from domestic livestock. Today, there are only ~500 SNBS remaining in the wild, with animals distributed amongst 14 unique herds. Barriers to SNBS population growth come in many forms. Survival and reproduction are limited by sheep body condition through climatic conditions. Severe winters act as a pulse disturbance on the population, with many animals dying of starvation or in avalanches, while the effects of long-term drought limit nutritional resources in a press disturbance. Top-down pressure via predation by mountain lions (*Puma concolor*) accounts for roughly 50% of SNBS mortality each year. Mountain lions pose a press disturbance to SNBS herds, as they consistently remove animals from the population in the spaces they overlap with SNBS. Pathogen introduction risk is a constant threat that would require rapid, decisive action to minimize

mortality and disease spread between connected SNBS herds. Disease outbreak could have rapid deleterious effects on SNBS herds, acting as a strong press disturbance and potentially undoing decades of population recovery. Optimal management for SNBS will require balancing resources given that each of these threats operate on different temporal scales and have unique consequences on SNBS demographic rates. Together, we will examine these 3 barriers to Sierra Bighorn population growth (predation, climate, and disease) and provide recommendations to wildlife managers.

Keywords: Bighorn Sheep, Mountain Lion, Disease, Climate Change, Body Condition

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Funding Source(s): California Department of Fish & Wildlife

MOUALLEM, N. Effects of high severity reburn wildfires on ponderosa pine regeneration and plant community composition. M.S. student

Wildfire is a fundamental ecosystem process that has historically maintained ponderosa pine forests (*Pinus ponderosa*) across western North America. However, 20th century fire suppression, livestock grazing, and logging have altered many features of ponderosa forest structure, such as increasing tree densities and surface fuels. Historical low-severity, frequent fire regimes have been altered, and these forests are now experiencing increased high severity fires. High severity fires can lead to conversion from ponderosa to non-forest vegetation, and high severity patches that subsequently reburn can create novel disturbance interactions and legacy effects on the landscape. In my research I will use observational field protocols to collect data on ponderosa pine regeneration and plant community composition to answer the following questions: After an initial high severity fire, how does a reburn wildfire impact post-fire conifer regeneration and community composition in ponderosa pine forests? Does the severity of the second fire have any ecological significance? While there are some studies that examine reburns in the field, none examine the effects of high severity reburns on ponderosa pine regeneration in the Southwest. Ten reburns in ponderosa pine forests across the Colorado Plateau were selected based on proportion of high severity reburn area, proximity to roads, and topography. This research will provide valuable insight on the ecological trajectory of high severity reburns in ponderosa pine forests, such as the likelihood of non-forest conversion and shifts in understory community composition toward non-native species (such as cheatgrass), which are major concerns for land managers.

Keywords: Fire Ecology; High-Severity Fire; Pinus Ponderosa Forest; Reburn Wildfires; Understory

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Funding Source: Southwest Climate Adaptation Science Center

BERGERON, N.J. Quantifying changes in aspen forest cover in northern Yellowstone National Park after wolf reintroduction. M.S. student

Yellowstone National Park is an iconic yet still unresolved case study in the ecological consequences of large predator recovery. A key focus of debate concerns the indirect effect of wolves (*Canis lupus*) on the regeneration of overstory aspen (*Populus tremuloides*) trees in northern Yellowstone via reductions in elk (*Cervus canadensis*) browsing pressure. Prior research focused on changes in the height of young aspen (≤ 600 cm and ≥ 1 year-old) contends that wolves have facilitated recovery of historically overbrowsed aspen stands by reducing elk density and/or altering elk foraging behavior. However, this research has relied on selective sampling of the tallest young aspen and the implicit assumption that positive trends in height of young aspen is an accurate indicator of increasing stand area. Importantly, this key assumption has not been tested, nor have studies quantified changes in aspen stand area since the reintroduction of wolves. Doing so is necessary because aspen forest recovery in northern Yellowstone is not uniform, with many stands continuing to decline despite the presence of wolves. My research will address this critical knowledge gap by utilizing aerial photography and long-term aspen sampling data to quantify changes in aspen areal extent across northern Yellowstone from 1994-2023, focusing mainly on the period after 2006 when NAIP imagery became available. Specifically, I will evaluate stand area and canopy cover changes in more than 100 aspen stands containing long-term sampling plots to determine the direction and magnitude of change in aspen areal extent and examine whether plot-level trends in young aspen height are representative of trends in stand area. My research will provide new insight into aspen forest recovery in northern Yellowstone, clarify the relationship between changes in young aspen stem height and stand area, and improve understanding of the ecological consequences of wolf reintroduction.

Keywords: Aspen; Browsing; Elk; Wolves; Yellowstone

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Funding Source(s): Veteran Readiness and Employment Program, University of Wyoming-National Park Service Small Grant Program

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ENGELBERT, L.M. Ecological monitoring of mammalian carnivores. Ph.D. student

Intraguild interactions can drastically shape the population dynamics of carnivores through alterations in species' behavior. Yet models of carnivore populations typically focus on prey distributions and densities, ignoring an important component of carnivore community ecology – competition between sympatric species. As the human-wildlife interface grows, carnivores are increasingly occupying multi-use landscapes that require them to balance their behavioral responses to anthropogenic activity with their responses to sympatric carnivores. Understanding the complexities of how the combined pressures of intraguild competitors and humans impact the behavior of a suite of carnivores is a challenging endeavor that necessitates accurate measurements of abundance, density, and health. These population metrics can change quickly when there are perturbations to ecosystems and have direct consequences for populations of sympatric carnivores and their prey. An improved understanding of these influences on the behavior, health, and population dynamics of terrestrial carnivores will inform management decisions and allow for rapid responses to ecosystem changes. As such, the goal of my dissertation is to quantify how interspecific interactions, anthropogenic activity, and disease impact a suite of carnivore species simultaneously. To fully understand these impacts, my objectives are

to determine 1) how best to monitor carnivore populations, 2) what pathogens are present and of concern, and 3) how carnivores balance the combined pressures of human hunting and intraguild competition. The results of these objectives will then be used to develop a predictive understanding of carnivore populations to use when survey information is incomplete or insufficient. These models will provide managers with critical information on carnivore ecology and how best to manage ecosystems at the community level.

Keywords: Carnivores; Community Ecology; Intraguild Interactions

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Funding Source: Utah Division of Wildlife Resources

MUZZO, I.B. Behavior, welfare, performance and environmental impacts by cattle grazing a grass monoculture and improved with islands of diversity. Ph.D. student

U.S. rangelands represent 31% of the country's land area, supporting approximately six million beef calves. Under this context, cow-calf pairs typically graze grass monocultures with nutritive values that plummet in mid-summer, a pattern which has been exacerbated by climate change. Such decline disrupts nutrient cycles and burdens producers with system inefficiencies and high supplementation costs. Legumes and forbs may provide a significant input of nutrients and bioactives to ruminants, reducing carbon and nitrogen (N) footprints while enhancing animal nutrition and health. Therefore, my project is aimed at exploring the benefits to livestock and their environment achieved by the creation of multifunctional alternative foodscapes using strategically distributed legumes and forbs as resource patches across rangelands. Thirty beef cows will graze a 55-acre pasture divided into six paddocks. Three paddocks will serve as control treatments (CT; grass), and three paddocks will represent the smart foodscape treatment (SFT): grass+food patches or “islands of diversity" (3/paddock) seeded with strips of: alfalfa, birdsfoot trefoil, forage kochia, sainfoin, and small burnet. Over three years, 5 cows/paddock will graze CT and SFT treatments from July to September. Forage intake and pasture use will be estimated by the herbage disappearance method, and forage nutritive value will be assessed. Animal weight gains, body condition scores, weaning weights and pregnancy rates will be recorded. Cow behavior and spatial distribution (grazing time, steps, laying bouts and overall activity) will be monitored using GPS collars and accelerometers. Animal health (antioxidant state) and welfare (cortisol) parameters will be evaluated through blood and hair samples, respectively. Enteric CH4, urinary and fecal N emissions will also be assessed. The data will be analyzed through mixed-effects analysis of variance in a generalized linear mixed model. These findings will help understand some of the benefits of landscape interventions on livestock production systems and rangeland sustainability.

Keywords: Behavior, Health, Performance, Cortisol, Methane Emissions

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Funding Source(s): USDA-NIFA-funded smart foodscape project

EGGLESTON, R.B. Habitat use and movement of pinyon jays (*Gymnorhinus cyanocephalus*) in relation to piñon-juniper removal treatments and wildfire recovery. Ph.D. student

The Pinyon Jay (*Gymnorhinus cyanocephalus*) has been in decline throughout its range for several decades and there is overall little literature on jays, particularly in the edges of their range. The cause of this decline is unclear, but key hypotheses include habitat alterations associated with climate change and piñon-juniper (PJ) forest removal treatments conducted to curb PJ encroachment into sagebrush ecosystems and to reduce fuel availability. Established practices for managing sagebrush ecosystems, such as PJ removal, may intersect adversely with increasing conservation efforts for Pinyon Jays potentially lead to conflicts between management regimes. Northwest Box Elder county in Utah and southern Cassia county in Idaho both have significant PJ removal treatments underway or already completed in the past decade, and also lie on the northern edge of Pinyon Jay range. To assess whether PJ removal is having an effect on Pinyon Jay habitat selection and use, we are conducting road-based breeding surveys on 43 5 km^2 plots throughout the northwest corner of Utah and south-central Idaho, March through May, to locate active nesting colonies, areas of high jay occurrence. We will also trap Pinyon Jays at four sites and deploy GPS tags to collect fine-scale data and use second and third order resource selection functions to evaluate jay movement and habitat use. Because working knowledge of Pinyon Jay ecology is sparse in the northern Great Basin, we intend to use this data to determine breeding locations, food sources, vocal variation, mean home range size, and other characteristics that will be of value to managers in this region of Utah and Idaho.

Keywords: Management Perceptions; Movement; Pinyon Jay; PJ Removal; Resource Selection; Wildfire Recovery

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Funding Sources: UDWR and BLM Utah

THORPE, V.E. Golden eagle predation of greater sage-grouse. M.S. student

Understanding the role of predator-prey relationships in various contexts, habitats, and locales remains a priority in ecological studies. Golden eagles (*Aquila chrysaetos*) are year-round residents in the sagebrush ecosystem and are one of the predators of adult greater sage-grouse (*Centrocercus urophasianus*; i.e., sage-grouse). Although it may be rare to witness golden eagle predation of lekking sage-grouse, there are many accounts of how the presence of golden eagles affect sage-grouse behavior at leks. Quantifying how sage-grouse react to various predators at the lek and the duration of responses will provide more information on relationships between sage-grouse and their predators during the lek period. The goal of this study is to gain understanding of golden eagle predation of sage-grouse by (1) evaluating the influence of golden eagle presence on greater sage-grouse lek counts and behavior and (2) examining the prevalence of sage-grouse in golden eagle diet, including in relation to alternative prey. To meet this goal, I will conduct sage-grouse lek counts and observational surveys for golden eagles and other predators, and use nest cameras and DNA metabarcoding analysis of mute and pellet samples to identify golden eagle prey items. Golden eagles and sage-grouse are

both considered Utah Species of Greatest Conservation Need. Although golden eagles are one of the many predators of adult sage-grouse, the magnitude and extent of their impact is unclear and examining this relationship could help guide management and conservation actions for both species.

Keywords: Golden Eagle; Greater Sage-Grouse; Lek Predators; Sagebrush; Diamond Mountain; Eagle Diet

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SCHIFFER, A. Functional traits as a tool for predicting coexistence in heterogeneous landscapes. Ph.D. student

A central goal in ecology is to understand how species coexist in diverse ecological communities. Coexistence theory suggests that environmental variation in space and time contributes to stable coexistence and the maintenance of biodiversity. Despite this, empirical studies of coexistence in plant communities often omit spatial heterogeneity and fail to make model parameters a function of the environment. Additionally, they are often species-specific, limiting our ability to make general predictions. Understanding how spatial heterogeneity contributes to species coexistence is critical because climate and land use change are altering our landscapes, particularly in the Intermountain West. To inform conservation and land management, we need mechanistic studies that link spatial variation and species coexistence. I aim to address these gaps by studying 1) how excluding spatial heterogeneity introduces bias in coexistence studies, 2) which functional traits predict coexistence with fine-scale spatial heterogeneity, and 3) how functional trait variation determines the strength of competition across a heterogeneous landscape. I predict that 1) heterogeneity is a significant predictor in all study types, but especially in observational studies where local dispersal and species sorting has already occurred; 2) fine-scale variation in a limiting resource will make traits related to resource acquisition most important for competition; and 3) coarse-scale variation along an environmental gradient will cause greater trait dissimilarity and mediate competition. For Aim 1, I will simulate competition between plants in observational and experimental studies with and without spatial heterogeneity. For Aims 2 and 3, I will establish plots along an environmental gradient in an Idaho sagebrush steppe and measure resource availability, individual functional traits, and population growth to assess within- and between-plot trait variation and competition. Connecting spatial heterogeneity and functional traits to coexistence will provide insights on biological processes for maintaining diversity and improve projections of invasion and community composition under global change.

Keywords: Species Coexistence; Functional Traits; Sagebrush Steppe

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Funding Sources: NSF-DEB 1933561

SIEMION, E.A. The mechanistic underpinnings of predation in a multi-prey ecosystem. Ph.D. student

Predation is commonly represented as a dyadic interaction between a predator and prey species and is often regarded as a top-down process in which predator densities constrain prey densities. Prey populations can respond to a variety of extrinsic forces that determine the extent to which predators regulate their dynamics, so a bottom-up perspective that addresses predation rate – the rate at which prey are killed by predators (kills/prey/time) – its effect on prey vital rates, and its interaction with other extrinsic processes may better quantify predation effects on prey. In this project, I will explore how prey dynamics influence predation rates at the community, population, and individual levels and assess whether the dominant level at which predation operates shifts due to changes in the environment. In the Sierra Nevada of California, mountain lion (*Puma concolor*) predation is bolstered by a large mule deer (*Odocoileus hemionus*) population and poses a significant threat to the federally endangered Sierra Nevada bighorn sheep (*Ovis canadensis sierrae*; SNBS). Current California policy rarely approves the lethal removal of mountain lions but allows for translocations. However, we do not understand how predation operates in a fine-scale spatiotemporal context and therefore have limited knowledge for directing translocation actions. To understand the circumstances leading to elevated predation rates, we aim to 1) quantify the roles that bottom-up and top-down processes play in shaping predation rate; 2) determine how environmental factors affect densities of two prey species (mule deer and SNBS), and the spatial partitioning of those species across the landscape; and 3) assess the sensitivity of predator-prey interactions to shifting prey ecology at the community, population, and individual levels and evaluate how the environment mediates each process. With this framework, we can inform where predator-related management efforts will be most effective in aiding the recovery of Sierra Nevada bighorn sheep.

Keywords: Bighorn Sheep; Mountain Lions; Predation Rate; Predator-Prey Dynamics

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Funding Source(s): California Department of Fish and Wildlife

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BERGER, D.J. Seeing is be-leaving: perception informs migratory decisions in Sierra Nevada bighorn sheep. Ph.D. student

Seasonal migration is a behavioral response to predictable variation in environmental resources, risks, and conditions. In behaviorally plastic migrants, migration is a conditional strategy that depends, in part, on an individual's informational state. The cognitive processes that underlie how facultative migrants understand and respond to their environment are not well understood. We compared perception of the present environment to memory and omniscience as competing cognitive mechanisms driving altitudinal migratory decisions in an endangered ungulate, the Sierra Nevada bighorn sheep (Ovis canadensis sierrae) using 1,298 animal years of data, encompassing 460 unique individuals. We built a suite of statistical models to partition variation in fall migratory status explained by cognitive predictors, while controlling for non-cognitive drivers. To approximate attribute memory, we included lagged attributes of the range an

individual experienced in the previous year. We quantified perception by limiting an individual's knowledge of migratory range to the area and attributes visible from its summer range, prior to migrating. Our results show that perception, in addition to the migratory propensity of an individual's social group, and an individual's migratory history, are the best predictors of migration in our system. Our findings suggest that short-distance altitudinal migration is, in part, a response to an individual's perception of conditions on alterative winter range. In long-distance partial migrants, exploration of migratory decision-making has been limited, but it is unlikely that migratory decisions would be based on sensory cues from a remote target range. Differing cognitive mechanisms underpinning short and long-distance migratory decisions will result in differing levels of behavioral plasticity in response to global climate change and anthropogenic disturbance, with important implications for management and conservation of migratory species.

Keywords: Cognitive movement ecology; Memory; Perception; Ungulates

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Funding Source(s): Quinney Doctoral Fellowship, California Department of Fish and Wildlife, NASA ROSES Grant- The lifecycle of snow in the Sierra Nevada USA: from snowfall to snowmelt and effects on endangered bighorn sheep

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PARSONS, M.A. Predator-prey interactions between wild pigs and mountain lions. Ph.D. student

Introduced prey species can dramatically alter predator-prey interactions with consequences for wildlife management and conservation. Wild pigs (*Sus scrofa*) are a widespread introduced species in North America that could interact with native predator-prey systems in numerous ways. As a medium-sized ungulate, wild pigs could become prey for native carnivores, including mountain lions (*Puma concolor*). As omnivores, wild pigs may also act as scavengers, potentially affecting predators through kleptoparasitism. We explored the predator-prey interactions between mountain lions and pigs by examining mountain lion diet and pig scavenging behavior in a system where both species are abundant. We monitored GPS-collared mountain lions to identify kill sites and deployed cameras at fresh kill sites to monitor scavenging. Wild pigs, particularly juveniles, were an important secondary prey item for mountain lions, especially in winter when deer (*Odocoileus hemionus*) were less vulnerable. Wild pigs were also common scavengers of mountain lion kills, but only after mountain lions had left kill sites. Wild pigs scavenged at both deer and other pigs killed by mountain lions. Our results suggest wild pigs may disrupt native predator-prey interactions as a common prey species. However, scavenging by wild pigs is unlikely to have substantial impact on mountain lion foraging due to the late arrival of pigs at prey killed by mountain lions.

Keywords: diet, foraging ecology, prey selection, scavenging

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Funding Sources: USU Presidential Doctoral Research Fellowship; California Department of Fish and Wildlife; USDA National Wildlife Research Center

GARRETT, S.M., Differential effects of grazing by ungulates and lagomorphs in rangeland systems. Ph.D. student

Mixed species grazing of both domestic and wild herbivores is a common occurrence in rangelands of the Western U.S. Traditionally, rangeland management has had a species-specific focus with an emphasis on domestic livestock, such as cattle. The Henry Mountain rangelands in Southern Utah are predominantly used for livestock and hunting. Consequently, lethal control of coyotes occurs multiple times annually through agency-led measures. Coyotes are the primary predator of lagomorphs in this area; thus, their removal may lead to a trophic imbalance at the grazing level due to increased lagomorph densities, mainly jackrabbits. This imbalance, which is an indirect outcome of management, may propagate down to the plant production level, altering biodiversity, quality, and annual productivity. Quantifying the separate effects of grazing induced by both large and small herbivores is essential for understanding how grazing pressure impacts the landscape. My central hypothesis is that lagomorph herbivory has a driving influence on biodiversity, biomass, and nutrient composition at the plant production level. Using a replicated exclosure study, we measured the effect of lagomorphs on community composition, aerial cover and standing crop after 8 years of treatment. Exclosures that allowed lagomorph foraging but excluded ungulate grazing developed a community with higher forb biomass (33.6% increase relative to open rangeland) and lower forb species richness (16.4% decrease relative to open rangeland). This effect was mainly caused by the encroachment of noxious weeds, including snakeweed and Russian thistle. Next, we collected 2 years of productivity data to quantify the effects of lagomorphs on aboveground net primary productivity for different plant functional types. We found that where only lagomorphs were included, there was significantly lower grass biomass and higher forb biomass, suggesting that the selective grazing behaviors of lagomorphs provide some competitive advantage to forbs.

Keywords: ANPP, community ecology, food-webs, grazing interactions, rangeland ecology

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Funding Sources: USU Public Lands Initiative; Utah Bureau of Land Management

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MALONEY, D.M. Active Sampling of golden eagle nestling diet and associations with habitat across western Utah between 2020 and 2022. Ph.D. student

Golden Eagles (*Aquila chrysaetos*) are generalist apex predators that inhabit a substantial portion of the western United States. They are a species of concern in Utah and are protected under federal regulations nation-wide. In Utah, long-term information on the diet of nesting golden eagles exists due to extensive passive sampling surveys completed by field naturalists, such as Kent Keller. In the passive sampling method, data is collected during a single or over a few visual surveys for prey remains in and around a nest. This method is potentially limited by the size and frequency of the species selected; with smaller prey remains being more easily destroyed or overlooked and underrepresented. For a predator such as the Golden Eagle, that will prey upon a variety of small- to medium-sized species, inhabits a wide range of habitat types, and is currently

experiencing a disease-mediated crash in its primary prey species, the Black-Tailed Jackrabbit (*Lepus californicus*), understanding how prey selection shifts could be critical to proactive management. Using an active sampling approach to understand diet composition (i.e., trail cameras mounted near nests), we used motion-activated photography to capture data on golden eagle adult prey deliveries and nestling feeding events, across western Utah. Habitat differences also play a large role in available prey species and after considering habitat cover types in our analysis, we saw substantial association among habitat cover types and prey selection. We will present preliminary findings from data collected at 54 nest cameras, encompassing 50 different golden eagle territories across western Utah, between 2020 and 2022.

Keywords: Active Sampling, Prey; Habitat; Golden Eagle

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Funding Source(s): Dugway Proving Ground, Hawkwatch International, National Fish and Wildlife Foundation

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WILDLAND RESOURCES GRADUATE RESEARCH SYMPOSIUM
Friday, April 14, 2023
Huntsman Hall, room 320

A.M.

8:20 **Opening Remarks**

8:30 WAYMAN, Mike
8:45 STOKES, Bonnie
9:00 TARAPOREVALA, Neville
9:15 STOSICH, Alex
9:30 ALVES, Molly

9:45-10:10 ***Morning Break***

10:15 HELCOSKI, Ryan
10:30 JOHNSON, Brittany
10:45 DEL BOSCO, Tate
11:00 MOUALLEM, Nadav
11:15 BERGERON, Nicholas
11:30 ENGELBERT, Lindsey

11:45-12:55 ***Lunch Break (on your own)***

P.M.

1:00 MUZZO, Bashiri Iddy
1:15 EGGLESTON, Rory
1:30 THORPE, Tori
1:45 SCHIFFER, Annie
2:00 SIEMION, Liz

2:15-2:25 ***Afternoon Break***

2:30 BERGER, Danielle
2:45 PARSONS, Mitch
3:00 GARRETT, Shantell
3:15 MALONEY, Dustin

3:30 **Closing Remarks**