2016 CMPS Annual Meeting Abstracts

"Seeing Wildlife through the Trees:
Challenges and Conservation of Forests & Wildlife"
August 8-11, 2016
Steamboat Springs, CO

Plenary Session Abstracts:

Collaboration as a Model for Wildlife Habitat Management in Changed Landscapes

Rick Truex, *USDA Forest Service*

During the past decade, forest landscapes throughout the region have experienced dramatic changes due largely to bark beetle outbreaks and wildfire. In addition to these changes, wildlife populations face challenges from invasive species, wildlife diseases, recreation, and the interaction between landscape disturbance and anthropogenic stressors. This presentation will highlight some of the important factors influencing forest-dependent wildlife and explore the role of collaboration as a framework to conserve wildlife while also meeting other resource management objectives. In 2010 the Forest Service began its Collaborative Forest Restoration Program (CFLRP) - a program designed to encourage collaborative, science-based ecosystem restoration. The Front Range CFLRP and the Uncompahgre Plateau CFLRP projects provide 2 local case studies to compare and contrast how collaborative processes influence forest wildlife conservation. Both landscape-scale efforts have demonstrated success in integrating wildlife conservation objectives into their landscape restoration approaches, though in very different ways. Measuring success and effectiveness of restoration requires monitoring, and specific monitoring questions and approaches are determined by each CFLRP. The Front Range CFLRP has emphasized wildlife monitoring and relies on monitoring a suite of avian species across the landscape. In addition to the successes each CFLRP has experienced, challenges have been encountered- particularly with respect to integrating science into management.

Wildlife, Habitat, and Fire: A case study for habitat restoration

Melissa Dressen, *USDA Forest Service*

Historic fire patterns have been altered across the west with fire suppression along with changes in fuel conditions, vegetation patterns, and climatic conditions. With these changes, wildlife habitats are likely experiencing changes that are outside the historical range of variability. In some cases, habitats have remained for decades in a late successional phase which may alter the wildlife dynamics, distribution, and species composition. Prescribed fire can be introduced on the landscape to restore habitats for a variety of wildlife species including big game. Initiating a pattern of regular fire intervals can keep habitats in a mosaic of

successional stages, particularly important for vegetation that may have had a frequent fire return interval in the past. This case study explores fire ecology, application of fire, and the response by wildlife to the habitat changes.

Rocky Mountain High Elevation Five-needle White Pine Communities: Wildlife Habitat Under Threat
Diana F. Tomback, *University of Colorado-Denver*

High elevation five-needle white pine communities comprise important wildlife habitat throughout the Rocky Mountains. The pines include whitebark, limber, Rocky Mountain bristlecone, and southwestern white. They vary in geographic distribution, but all produce nutritious seeds that are consumed by a multitude of birds and small mammals and even bears and foxes. The four species are pioneers after disturbance such as wildfire, but successional on productive sites. The hardiness and stress-tolerance of three species—whitebark pine, limber, and bristlecone pine—enable them to grow at high elevations where they provide ecosystem services, such as snow and soil retention. These communities are under threat from the combination of mountain pine beetle outbreaks, introduced white pine blister rust, fire exclusion, and climate change. Restoration strategies are at various stages of development for all four species, but it will take support and determination to see these plans realized.

Wildlife Responses to Bark Beetle Outbreaks: The Role of Spatiotemporal Complexity in Post-Disturbance Forests
Tracey Johnson, *University of Idaho*

Bark beetle outbreaks have become increasingly widespread in western North American forests. However, predicting responses of wildlife to habitat conditions after outbreaks is limited by a lack of empirical studies. Post-outbreak forests are complex and dynamic, and include many vertebrate wildlife species, multiple tree host-pathogen associations, spatial heterogeneity from previous disturbance, and time-dependence in the development of post-outbreak conditions. These complexities must be considered when making predictions and management decisions regarding wildlife responses to bark beetles, along with potential interactive, cascading, and nonlinear responses from wildlife. In this presentation, the current state of knowledge of wildlife responses to bark beetle outbreaks will be assessed, and considerations for future research and management will be discussed.

Impact of Bark Beetle Outbreaks on Mammals in Colorado
Jake Ivan, *Colorado Parks and Wildlife*

Bark beetles have impacted approximately >1.6 million hectares in Colorado since the initial outbreak began in 1996. Though bark beetles are native to Colorado and periodic outbreaks are considered a natural ecological process, the geographic scale of their impact and simultaneous infestation within multiple forest systems has never been observed. We used

occupancy estimation to determine how mammalian use of forest stands has changed as a result of these outbreaks. Engelmann spruce–subalpine fir and lodgepole pine systems were sampled statewide, and sampling covered a variety of conditions including areas that had not yet been impacted by beetles, areas that were impacted only recently, and those that were impacted a decade ago. Response of the mammalian community to this large-scale disturbance was varied. Some species, such as red squirrels, decreased their use of an area after bark beetles moved through. Others, such as elk increased their use of such areas. Still others showed no response (e.g., *American marten*).

Oral Presentation Abstracts:

Using integrated population models to understand spatio-temporal patterns of American Black Bear population ecology in Colorado

Jared S. Laufeberg, *Department of Fish, Wildlife, and Conservation Biology, Colorado State University*
Heather E. Johnson, *Colorado Parks and Wildlife*
Paul F. Doherty, *Department of Fish, Wildlife, and Conservation Biology, Colorado State University*
Stewart W. Breck, *USDA Wildlife Services*
Mark Viera, *Colorado Parks and Wildlife*

Understanding how biotic and abiotic factors affect the distribution and population dynamics of American black bears (*Ursus americanus*) is an important and growing priority for wildlife managers throughout North America. In the western U.S., habitat conditions are known to influence black bear demographics and space use, but how those factors affect bear populations near urban environments is not well understood. We integrated spatial capture-mark-recapture data and GPS-telemetry data from 3 study areas to understand how habitat conditions affect spatial and temporal patterns in American black bear population density in Colorado. Our unified analysis resulted in inference on population abundance and density, population dynamics, and 2nd- and 3rd-order resource selection. We were able to draw inferences on how factors such as forest cover and human development influence spatial and temporal variation in population density. Coordinating independent studies to achieve such inferences can be logistically or financially difficult, whereas study designs that formally integrate multiple data sources may be more feasible and yield inferences across multiple components of wildlife population ecology. We discuss our results in light of current needs for accurate and obtainable information on the spatial and temporal distribution of black bears near urban environments in Colorado.

Drivers of Mountain lion movement in the Colorado Front range

Frances E. Buderman, *Department of Fish, Wildlife, and Conservation Biology, Colorado State University*
Mevin B. Hooten, *US Geological Survey, Colorado Cooperative Fish and Wildlife Research Unit*
Mat W. Alldredge, *Colorado Parks and Wildlife*

Assessing preferential use of the landscape is important for managing wildlife and can be particularly useful in transitional habitats, such as at the wildland-urban interface. We characterized preferential habitat selection by a population of mountain lions (*Puma concolor*) inhabiting the Front Range of Colorado, an area exhibiting rapid population growth. Preferential use is often evaluated using resource selection functions (RSFs), but they do not account for the habitat available to an individual at a given time and may mask conflict or avoidance behavior. Contemporary approaches to account for availability based on movement include spatio-temporal point process models, stepselection functions, and continuous-time discrete-space (CTDS) models. We used a continuous-time discrete-space (CTDS) framework to model transition rates among gridcells as a function of landscape covariates. The CTDS framework is based on an underlying movement model and allows for inference on the same spatial scale as the covariates. We exploited the flexibility of the CTDS framework to accommodate location- and gradient-based drivers of movement, individual variation, and timevarying responses to variables such as prey availability, development, topography, and canopy cover. Significant population-level responses were difficult to detect given the large variability in the individual-level responses.

Influence of bark beetle epidemic on elk and hunter movements and interactions

Bryan G. Lamont, *US Geological SurveyWyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming*
Tony W. Mong, *Wyoming Game and Fish Department*
Kevin L. Monteith, *US Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming*
Matthew J. Kauffman, *US Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming*

The forests of the western United States have been changing dramatically due to the bark beetle epidemic. Resource selection of large ungulates is influenced by factors such as nutrition, energetic cost and hiding and thermal cover. As the epidemic changes the forest, ungulates that inhabit these areas may alter their resource selection patterns to adapt to changing habitats. Moreover, ungulate distributional shifts and beetle-kill downfall may also lead to changes in the patterns of human hunters, which are the primary predator of ungulates in affected forests. We are evaluating how the resource selection of elk (*Cervus elaphus*) and human hunting patterns are being influenced by the bark beetle epidemic in the Sierra Madre Mountains of southcentral Wyoming. From 2012 to 2015, we outfitted 60 cow elk with GPS collars and obtained 450 daily GPS tracks of hunters to document their movements in and

around beetle kill. We are using a satellite–derived land classification of forest change to evaluate resource selection of elk during various stages of beetle-killed forests. We are coupling this analysis with an analysis of how beetle kill is influencing hunter movements and interactions with elk. Our work will provide novel insights into how the bark beetle epidemic will influence elk resource selection and hunter effort, and this information will inform wildlife and forest management decisions regarding ungulates and hunting in beetle killed forests.

Correlation and utility of moose thyroid hormones for predicting overall condition and pregnancy status

Eric Bergman, *Colorado Parks and Wildlife*
Mark Fisher, *Colorado Parks and Wildlife*
Lisa Wolfe, *Colorado Parks and Wildlife*

During the last 10-15 years it has become increasingly evident that moose herds in the Rocky Mountains experience meaningful amounts of regional and temporal variation. Several herds in the northern latitudes of this region have demonstrated declines, yet no evidence of a decline has been observed in Colorado. However, in light of these regional dynamics, wildlife biologists in Colorado have highlighted a need for new tools to better manage moose herds. In an attempt to provide more detailed information on moose herd productivity, during December of 2013 we initiated a 7 year study that includes 3 of Colorado's moose herds. Preliminary evidence from this work has shown that moose pregnancy rates are variable among study areas. In order to determine if pregnancy rates can be used to inform management decision making, we must first identify the underlying sources of variation within those rates. Thyroid hormones (tyroxine and triiodothyronine) play fundamental roles in thermoregulation and regulating the basal metabolic rate of mammals. Variation within the concentration of these hormones has been interpreted as physiological adjustment to environmental conditions. Accordingly, thyroid hormones have the potential to inform managers on the intermediate nexus between animal condition and productivity. While preliminary correlative evidence from our works suggests that thyroid hormones capture only a small amount of variation within moose pregnancy rate data, the utility of winter thyroid hormone concentration data may be more fully realized when coupled with other, non-hormonal body condition metrics.

Monitoring breeding greater sandhill cranes in northwest Colorado

Liza Rossi, *Colorado Parks and Wildlife*
Jim Gammonley, *Colorado Parks and Wildlife*
Mindy Rice, *Colorado Parks and Wildlife*

The greater sandhill crane (*Grus canadensis tabida*) is a species of special concern in Colorado and is listed as a Tier One species in the Colorado State Wildlife Action Plan. In 2015, we initatied a pilot study to test whether a ground-based occupancy sampling approach could be applied to monitor Rocky Mountain Population (RMP) greater sandhill cranes on their breeding range in Colorado. We first developed a "high probability crane nesting habitat" model to define our sampling frame. Sample catchments were defined to include all wetlands and

riparian drainages within a 55 hectare area. Two independent surveys were completed for each catchment during the nesting period. Twenty survey catchments were generated from the high probability crane nesting habitat sampling frame. An additional 20 survey catchments were pulled from an intersection of high probability crane nesting habitat and historic nest site locations. We ran competing models in Program Mark with a possible site covariate of model (modeled habitat vs. historic nest site) and with possible survey covariates of visit and week of sampling. Based on the best-fit model, which included a constant site occupancy (ψ) and variable detection (p) by visit, we estimated an occupancy of ψ = 0.444 (95% CI 0.277 – 0.626) for crane nests within high probability crane nesting habitat in Routt County. Detection estimates differed by visit. Detection estimates for locating a crane nest within a catchment were p(visit1) = 0.875 (95% CI 0.463 – 0.983) and p(visit2) = 0.500 (95% CI 0.300 – 0.740).

Coming to a state near you? Short-eared owl citizen science surveys

Neil Paprocki, *HawkWatch International*
Robert A. Miller, *Intermountain Bird Observatory, Boise State University*
Jay D. Carlisle, *Intermountain Bird Observatory, Boise State University*

Recent scientific evidence suggests Short-eared Owls (*Asio flammeus*) are experiencing range-wide, long-term population declines in North America. However, the cause and magnitude of the decline is not well understood. Booms et al. (2014) offered six conservation priorities for the species, and our project seeks to initially address the first two: 1) better define habitat use; and 2) improve population monitoring. We recruited over 180 citizen scientists and professional volunteers in 2015 and 2016 to survey more than 100 transects within Idaho and Utah. Transect areas were selected using a Generalized Random Tesselation Stratified (GRTS) spatially balanced draw within potential Short-eared Owl habitat. Volunteer surveys were conducted from March – May, and required a commitment of two evenings per survey area. We performed multi-scale occupancy modeling to identify habitat associations and map breeding distribution within the study area, and performed multi-scale abundance modeling to generate the first state-wide population estimates. Our survey methodology has broad appeal and we have tentative plans, in collaboration with the Intermountain Bird Observatory and other organizations, to up-scale our survey effort to 8 Pacific Flyway states in 2017. This would significantly increase our ability to track inter-annual abundance patterns for this highly nomadic species. Overall, our results demonstrate the feasibility, efficiency, and effectiveness of utilizing public participation in scientific research to achieve a robust sampling methodology across the broad geography of the western United States.

Multi-state wolverine monitoring and conservation

Nichole L. Bjornlie, *Wyoming Game and Fish Department, Lander, WY*
Zack Walker, *Wyoming Game and Fish Department, Lander, WY*
Diane Evans Mack, *Idaho Department of Fish and Game, McCall, ID*
Rex Sallabanks, *Idaho Department of Fish and Game, Boise, ID*
Justin Gude, *Montana Fish, Wildlife, and Parks, Helena, MT*
Bob Inman, *Montana Fish, Wildlife, and Parks, Helena, MT*
Bob Lanka, *Wyoming Game and Fish Department, Cheyenne, WY*
Jeffrey Lewis, *Washington Department of Fish and Wildlife, Olympia, WA*
Scott Jackson, *United States Forest Service, Missoula, MT*
Rick Kahn, *National Park Service, Fort Collins, CO*

Wolverines (*Gulo gulo*) have a circumpolar distribution that historically extended to California and New Mexico. Since 1920, wolverines have recolonized portions of their former range, although extent of recolonization is unknown. Concerns about the vulnerability to climate change led to a petition to list the species in 2000, and a federal court ruling recently remanded the 2014 not warranted finding. In 2015, Idaho, Montana, Washington, and Wyoming, with support of the Western Association of Fish and Wildlife Agencies, initiated the Western States Wolverine Conservation Project to assess current distribution and identify conservation actions. That year, the Wyoming Game and Fish Department (Department) funded a project to develop and evaluate techniques to detect wolverines and estimate occupancy. From a survey of 18 grid cells, we estimated occupancy at 62.9% (95% CI: 36.2 to 83.7) and probability of detection at 32.1% (95% CI: 12.8 to 57.5), giving a high probability of detection over the 5-month sampling period (0.86). Based on ventral pelage, ≥3 wolverines were detected during the effort. In 2016, using protocols developed by the cooperating states and others, the Department completed the first of a 2-year effort to sample the western mountains in Wyoming; we detected ≥2 wolverines at 3 of 25 grid cells. This winter, the Department and cooperating states will complete surveys at 180 grid cells throughout wolverine habitat in the 4-state area. Results will be used to refine and identify gaps in distribution, establish a baseline for future monitoring, collect genetic samples, and elucidate population connectivity.

An examination of fungal diversity present on bats in Western North America using Mexican Free-tailed Bats (*Tadarida brasiliensis*) as a model organism

Erin M. Lehmer, *Department of Biology, Fort Lewis College*
Steven D. Fenster, *Department of Biology, Fort Lewis College*
Kirk Navo, *Head First Biological*

Little is known about the fungal flora of western North American bats including bats susceptible and non-susceptible to white-nose syndrome (WNS). Understanding the ectomycotal communities of these bats will provide knowledge on fungal transmission dynamics including possible spread of *Pseudogymnoascus destructans* (Pd), the fungus responsible for WNS. To gain an understanding of the fungal community structure of resident and migratory western bat species, in 2014 and 2015, we surveyed populations of Mexican free-tailed bats (*Tadarida brasiliensis*) and big-brown bats (*Eptesicus fuscus)* located in south-central Colorado, and

characterized the resident mycobiome using DNA sequence barcoding analysis. Our results indicated that phylum Ascomycota dominated the ectomycotal communities of both *Tadarida* and *Eptesicus.* Among *Tadarida,* we found seasonal differences in fungal flora, with diversity increasing from June to August, as well as differences between adults and juveniles, with juveniles having greater fungal diversity compared to adults. We isolated a number of fungal species that are capable of growing at low temperatures, indicating that both *Tadarida* and *Eptesicus* harbor viable psychrophilic fungi. Of particular significance was detection of 10 fungal isolates collected from *Eptesicus* that had a high (>99%) match to Pd, identified through sequence analysis of the ITS region of the genome. However, further investigation of the IGS and LSU genomic regions suggested a higher genetic match to other closely related *Pseudogymnoascus* species. Continued research comparing ectomycota of bats in WNS-affected versus unaffected areas will improve understanding of the extent fungal community composition influences the establishment of Pd in healthy bat populations.

Determining bison summer diet selection using the DNA barcoding and next-generation sequencing method

Joshua L. Leonard, *South Dakota State University*
Lora B. Perkins, *South Dakota State University*
Duane J. Lammers, *Olson's Conservation Bison Ranches*
Jonathan A. Jenks, *South Dakota State University*

Bison were historically distributed throughout North America with the northern edge of the distribution occurring in North-central Manitoba and surrounding provinces. Despite bison occupying the boreal zone of North America, little is known of their forage selection patterns when occupying a densely forested aspen ecosystem. In 2015, we initiated a study on Olson's Conservation Bison Ranch, Pine River, Manitoba, Canada, to examine forage selection patterns for bison among and within summer months (June–August). We hypothesized that vegetative composition of bison diets would be consistent with availability, diets would shift along with forage availability, and that bison diets would predominately consist of grass and sedge species. We opportunistically collected adult female fecal samples (N =108) and identified forage composition using the DNA barcoding method. We estimated availability of forage to the lowest taxonomical level possible using a modified Daubenmire frame. Overall, bison diets were comprised of 44.3% grass, 37.7% forb, 16.3% browse, and < 2% sedge and rush. Forage availability was comprised of 51.2% grass, 28.3% forb, 1.7% browse, 11.0% sedge, and 7.6% rush. All analyses indicated that use and availability differed (P ≤ 0.05) for each taxonomical group throughout the summer. Grass and forbs were important dietary components for bison, comprising > 80% of bison diets. However, bison selected for these two dietary components independently as the summer progressed; selecting for grass during June and selecting for forbs during July and August. Our results indicate that these bison consume more browse (~ 16% of all diets) and other low cellulose, high cell soluble forages to meet their dietary needs. Thus, suggesting that bison may be or become intermediate foragers and are more similar to elk than

that of cattle or sheep when inhabiting forested systems at the northern edge of their historical distribution.

Dynamics of fleas and their small mammal hosts in mixed grass prairies: Implications for the maintenance of enzootic plague

Lauren P. Maestas, *Department of Biology, University of South Dakota*
Hugh B. Britten, *Department of Biology, University of South Dakota*

Maintenance of sylvatic plague (*Yersinia pestis*) is thought inefficient due to high mortality rates, yet recent findings indicate that low level enzootic plague may be maintained in susceptible prairie dog populations. An alternative theory to prairie dogs involves small mammals as an alternative reservoir and a "sea of plague approach". Pertinent to this "sea of plague" idea is the concept of a bridging vector allowing for the transmission of a pathogen from one system to another. This would require overlap in fleas between small mammals and prairie dogs, or other animals and challenges the notion of host specificity. This study compares the short grass ecosystem with that of mixed grass prairie, with regard to flea and mammal compositions and plague prevalence between hosts and vectors. Preliminary results show large differences between both the flea and mammal composition of the two systems and overall diversity. Moreover this study demonstrates that although small mammals may not play a large part in interepizootic plague cycling in shortgrass prairie ecosystems their role in mixed-grass prairies may be quite different from their shortgrass counterparts. Prevalence rates of *Y.pestis* among fleas and hosts, as well as potential overlap between fleas and hosts and overall implications for the involvement of small mammals in enzootic plague in mixed grass prairies will be discussed. Comparisons between years will also be made.

Status of Greater Sandhill Cranes in Colorado

Van K. Graham, *Colorado Parks and Wildlife (retired biologist)*

Sandhill cranes nesting in Colorado are the southernmost portion of the Rocky Mountain population of Greater Sandhill Cranes. Prior to European settlement of the west, cranes likely nested throughout Colorado's valleys, riparian corridors, and mountain marshlands. Crane populations declined during the rapid expansion of the West as miners and other pioneers arrived, altering the existing habitat essential to cranes and readily utilized the vast available wildlife resources as a primary food source. In the early and mid-1900s, sandhill crane populations slowly increased in response to wildlife harvest regulations, habitat improvements, and other conservation programs. During fall and spring migration, a large portion of the Rocky Mountain population stage in Colorado, primarily at Monte Vista National Wildlife Refuge in the San Luis Valley. Smaller staging areas occur along the Yampa River Valley near Steamboat Springs and Hayden. Cranes also stage for shorter periods during migration at Fruit Growers Reservoir near Eckert, Colorado. In the last 15-20 years, cranes have modified traditional migration patterns to New Mexico and large numbers now winter in Colorado along the Uncompahgre and Gunnison Rivers in westcentral Colorado. Interest in sandhill crane viewing has resulted in the establishment of two crane festivals; one held each March in Monte Vista

and one in September in the Steamboat Springs area. These festivals emphasize wildlife conservation and management of habitat, including the planting of grain crops that are important food sources for migrating and wintering sandhill cranes.

Factors driving hunter site selection between and within regions of concentrated hunting opportunities

Lindsey N. Messinger, *US Geological Survey, Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska-Lincoln*

Joseph J. Fontaine, *US Geological Survey, Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska-Lincoln*

Concerned with declining hunter populations, wildlife management agencies have developed numerous programs aimed at recruitment, development, and retention of hunters. Increasing the amount of publicly accessible hunting lands has been a primary goal of many of these programs, as access to hunting lands has been cited as a primary barrier to hunting participation. However, the effectiveness of many hunter retention programs remains largely unknown, and large-scale assessment of use of publicly accessible hunting lands is rare. To assist wildlife managers in determining how to best provide opportunities for sportsmen, we are conducting a large-scale, multi-year study to assess hunter use of publicly accessible lands across Nebraska. We combine visual hunter and vehicle counts with in-person interviews to gather information on hunter use and to determine hunter motivations, perceptions, satisfaction, and demographics. We are finding that use of publicly accessible lands is spatially uneven both across distinct regions within Nebraska as well as within those specific regions. Understanding how hunter demographics, typology, and other factors drive hunter site choice both between and within regions of concentrated hunting opportunity will be important in guiding future placement of public access lands and will help wildlife managers make decisions that foster future opportunities for sportsmen.

Piceance Basin Mule Deer Ecology and energy development

Chuck Anderson, *Colorado Parks and Wildlife*

The Piceance Basin mule deer winter range supports the largest migratory mule deer population in Colorado and one of the largest in North America. This area also contains some of the largest energy reserves in North America exhibiting extensive oil shale and natural gas deposits. Over the past 15 years, natural gas development has increased rapidly in this formerly undisturbed area with development activity representing over 200 active well pads and >800 km of access roads intermittently occurring throughout the 1,500 km^2 Piceance Basin mule deer winter range complex. To enhance understanding of mule deer/energy development interactions and evaluate potential mitigation approaches to benefit mule deer populations exposed to development disturbance, Colorado Parks and Wildlife initiated a long-term research effort beginning in 2008, which is scheduled to continue through 2018. Multiple collaborations with energy companies, NGOs and universities have provided for unique opportunities to address varying aspects of mule deer ecology and mitigation approaches from

disturbed and undisturbed landscapes. I will address preliminary results from the first 8 years of the project and highlight graduate student collaborations. In addition, I will present mule deer demographic data from this project for comparison to similar data collected from the same area during the 1980s and early 1990s, which demonstrate interesting changes in mule deer demographics and may provide insight into historic mule deer population trends.

Gray Wolf habitat in Colorado: Biological and social characteristics

Barry Noon, *Colorado State University*
Michael Soule, *Paonia, CO*
Mike Phillips, *Turner Endangered Species Fund, Bozeman, MT*

While the gray wolf (*Canis lupus*) was extirpated from Colorado in the 1940s, contemporary studies reveal that the state possesses biological and social characteristics that strongly favor the species' restoration. Western Colorado includes a notable assemblage of public lands that stretch across ~15 million acres that are managed for conservation purposes and support large populations of elk (*Cervus elaphus*) and deer (*Odocoileus viginianus* and *O. hemionus*). This is noteworthy since prey abundance explains the vast majority of variation in wolf population size when human-caused mortality of wolves is low. Not surprisingly, a 1994 congressionally mandated study conducted by the U.S. Fish and Wildlife Service concluded that western Colorado could support a viable population of wolves. Three additional studies conducted over the last 15 years, using more insightful and reliable techniques, support this conclusion. Notwithstanding the biological suitability of habitat, western Colorado is a considerable distance from wolf populations elsewhere. It is highly unlikely a viable population would come to inhabit the area through natural recolonization. Reintroductions would be required to restore the species to western Colorado. Notably there is significant public support for the wolf's return to Colorado. Several public opinion surveys conducted over the last 20 years indicate widespread support among Coloradans for restoration. This paper will consider the details of these studies, some consequences of restoring wolves to western Colorado, and a recently launched education effort to draw attention to this issue known as the Rocky Mountain Wolf Project.

Vegetation phenology and body condition of large herbivores

Mindy Rice, *Colorado Parks and Wildlife*
Kate R. Searle, *NERC Centre for Ecology and Hydrology, UK*
Chuck Anderson, *Colorado parks and Wildlife*
Chad Bishop, *Colorado Parks and Wildlife*
N.T. Hobbs, *Department of Ecosystem and Sustainability, Colorado State University*

Understanding the ways that spatial and temporal heterogeneity in climate and resources shape the performance of individuals and the dynamics of populations is central to sustainable management in changing environments. Emerging evidence has shown that herbivores track heterogeneity in nutritional quality of vegetation by responding to phenological differences in plants, differences resulting from spatial and temporal variation in conditions favoring plant

growth. We quantified the benefits mule deer (*Odocoileus hemionus*) accrue from accessing habitats with asynchronous plant phenology across four population segments in northwest Colorado over three years. We used structural equation modeling to examine links between variation in body condition (percent fat) of adult female mule deer, plant phenology metrics and weather. Our analysis examined both the direct physiological and indirect environmental effects of weather and vegetation phenology on mule deer body condition. We identified several significant effects of annual weather patterns and topographical variables on vegetation phenology in the home ranges of mule deer. Importantly, temporal patterns of vegetation phenology were linked with differences in body condition, with deer tending to show poorer body condition in areas with less asynchronous vegetation green-up and later vegetation onset. The direct physiological effect of previous winter precipitation on mule deer body condition was much less important than the indirect effect mediated by vegetation phenology. Additionally, the influence of vegetation phenology on body fat was much stronger than that of overall vegetation productivity. In summary, changing annual weather patterns, particularly in relation to seasonal precipitation, have the potential to alter body condition of this important ungulate species during the critical winter period. This finding highlights the importance of maintaining large contiguous areas of spatially and temporally variable resources to allow animals to compensate behaviorally for changing climate-driven resource patterns.

Social Media 101: Best practices for using social media as a wildlife professional
Tony Gurzick, *Colorado Parks and Wildlife*

Few people are likely to question the importance that social media plays in communication today. For example, as of April 2016, Facebook boasted 1.65 billion active users. The sheer amount of data created, the variety of social media platforms and the pervasiveness of social media on our culture can be overwhelming for some, especially from a professional standpoint. Many people feel the need to utilize social media to present research, management plans, educational content and networking opportunities; however, they are surprised when no one views their content. A successful social media strategy requires an understanding of the different social media platforms and a specific plan for each platform. By understanding how social media works and how individuals interact with social media, wildlife professionals can greatly improve their social media presence and their overall reach.

Ignite Presentation Abstracts:

To reduce black bear-human conflicts is it more effective to tackle bear behavior or human behavior?
Heather Johnson, *Colorado Parks and Wildlife*

To address the challenge of increasing human-black bear conflicts, wildlife agencies have employed numerous management actions targeted at both bears and people. Using data from

research conducted in Durango, Colorado, I will discuss some of the ecological and logistical challenges associated with managing each of these species, and raise some key issues that should be considered when managing human-wildlife conflicts.

Monitoring Wyoming's grassland species of greatest conservation need

Andrea Orabona, *Wyoming Game and Fish Department*

Four grassland-obligate species—Long-billed Curlew, Burrowing Owl, Upland Sandpiper, and Mountain Plover—are classified as Species of Greatest Conservation Need (SGCN) in Wyoming. However, they are not adequately monitored using existing methods like the Breeding Bird Survey and Integrated Monitoring in Bird Conservation Regions, so require species-specific survey techniques instead. We received Wyoming Governor's Endangered Species Account funds to address the following objectives: 1) create new, permanent survey routes for grassland SGCN using preferred habitat associations, historic distribution data, and availability of secondary public access roads; and 2) implement standardized, peer-reviewed, species-specific survey methods for long-term monitoring. Our 3rd objective is to address a Wyoming Game and Fish Department SGCN performance measure goal by using permanent personnel to assist the Nongame Program with SGCN monitoring in Wyoming's grassland habitats.

Wildlife managers' observations of the pine beetle occurrence in Middle Park Colorado 1998-2010

Mike Crosby, *Colorado Parks and Wildlife*

As a wildlife manager for the Colorado Division of Wildlife in Grand County, I observed the beetle kills occurrence and spread from the Williams fork valley across northern Colorado. The vegetative responses, land management shifts and how fire suppression and drought resulted in the largest habitat change I observed in my 34 year career.

Ultrasonic silent spring

Rob Schorr, *Colorado Natural Heritage Program, Colorado State University*

A 5-minute, fast-paced venture into bat ecology and conservation.

Timberline field institute at Colorado Mountain College – Leadville, Colorado

Katy Warner, *Colorado Mountain College, Natural Resources Management Timberline Field Institute, Leadville, CO*

The Timberline Field Institute provides paid summer field technician positions to Colorado Mountain College students in the Natural Resource Management Program. The Timberline Field Institute partners with approximately 20 different organizations to provide hands-on learning

opportunities that include water quality monitoring, habitat restoration, fen and wetlands delineation, STEM education, and much more! This Ignite talk will highlight the diverse array of current projects, partners, and participants.

Seven newly documented localities of the endangered New Mexico Meadow Jumping Mouse in Southwestern Colorado
Jennifer L. Zahratka, *Ecosphere Environmental Services, Durango, CO*

In 2014 and 2015 we conducted live-trapping presence surveys for the federally endangered New Mexico meadow jumping mouse on the Southern Ute Indian Reservation in southwestern Colorado. We successfully documented seven new localities along the Pine, Animas, Florida, and San Juan Rivers or their associated tributaries; this subspecies was previously known from only two locations in Colorado.

Trees, Water & People: Helping people and the planet at a Fort Collins nonprofit
Gemara Gifford, *Trees, Water and People*

Trees, Water & People (TWP) is a Fort Collins based nonprofit that promotes sustainable development and community-based conservation in rural areas across Central America, the Caribbean, and the Great Plains. Some of our projects include reforestation, sustainable agriculture, clean cookstoves, renewable energy technology, food sovereignty, and more recently biodiversity conservation. We work in some of the hardest to reach places where high levels of poverty and biodiversity converge, and we look forward to spreading our message to wildlife professionals across the world as we begin to build our biodiversity conservation program.

Who's using the highway 9 wildlife crossing structure?
Michelle Cowardin, *Colorado Parks and Wildlife*

The first wildlife overpass in Colorado is completed and functioning along State Highway 9 (SH 9). During 2015 CDOT finished the first of a two phase project to construct two wildlife overpasses and five wildlife underpasses along 10.5 miles of SH 9 south of Kremmling. In addition to the overpass there are three large wildlife underpasses, deer fence, escape ramps and deer guards on the completed phase of the project. SH 9 is the first of its kind in the state, with the sheer number of wildlife crossing structures concentrated in one area and the only wildlife overpasses. Colorado Department of Transportation and Colorado Parks and Wildlife along with the consulting firm ECO-resolutions have started a long-term monitoring study of the project to determine the effectiveness of the wildlife mitigation features.

Poster Presentation Abstracts:

Distribution of migrating marsh birds within and among moist-soil managed wetlands in Kansas

Eric Wilson, *Emporia State University*
William Jensen, *Emporia State University*
Richard Schultheis, *Kansas Department of Wildlife, Parks, and Tourism*

Moist-soil wetland management involves hydrological drawn-downs during early spring to enhance vegetative production, and flooding in the fall, to accommodate migrating waterfowl. Habitat use by other wetland-dependent birds within and among such wetlands has received little study. We examined use of variable habitat structure by migrating (spring and fall) bitterns and rails within and among moist-soil wetlands. We used call-playback surveys during spring and flush counts during fall. Abundances of marsh birds and water coverage and depth were correlated and varied markedly among the two years of study (2014-2015). In spring Sora were found in marshes with relatively tall *Polygonum,* a plant we found to have greater cover and height in wetland units with mid- and late-spring drawdowns. No other patterns of marsh bird abundance and habitat structure among wetland units were detected during spring or fall. During fall, American Bitterns were detected in areas within wetland units with higher cattail (*Typha*) coverage than Sora locations or systematic sampling points. Sora were detected in areas within wetland units with taller grass and *Polygonum,* higher *Polygonum* cover, and deeper water than American Bittern locations or systematic sampling points. Moist-soil management of wetlands could provide habitat for marsh birds through the use of mid to late season drawdowns in the spring and early pumping of water—or the closing of water control structures—in the fall to allow natural precipitation to fill wetlands.

Validation of road counts as an index of abundance for red-tailed hawks and American kestrels in the agricultural landscapes of south-central Nebraska

Thomas L. Freeman, *University of Nebraska at Kearney*
Casey W. Schoenebeck, *University of Nebraska at Kearney*

Raptor researchers often rely on road counts as an index for bird abundance or density; however, the robustness of the correlation between road counts and direct estimates of bird density has received little attention. We conducted road counts (1600 km sampled) and 243 variable circle plots to creating paired daily indexes and daily population density estimates to evaluate the relationship between these variables for red-tailed hawks and American kestrels in south-central Nebraska. Red-tailed hawk road counts ranged from 17 to 92 birds per 1000 km

traveled and were linearly related (R=0.60, F=4.7, df=1, P=0.06) to population density which ranged from 0.04 to 0.17 birds per square km. American kestrel road counts ranged from 0 to 34 birds per 1000 km traveled, and population density estimates ranged from 0 to 0.06 birds per square km. There was no significant correlation (R=0.38, F=1.5, df=1, P=0.25) between the two abundance measures for American kestrel. Observations suggest that American kestrels may exhibit a strong attraction to the roadways resulting in potential bias when utilizing road counts as an index of abundance. These data suggests road counts are a valid estimator of red-tailed hawk abundance while road counts are an unsuitable estimator of abundance for American kestrel in the in the agricultural landscape of central Nebraska.

Effects of sportspersons on local rural economies

Michael T. Winkler, *US Geological Survey, Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska-Lincoln*
Lindsey N. Messinger, *US Geological Survey, Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska-Lincoln*
Joseph J. Fontaine*, US Geological. Survey, Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska-Lincoln*

Large public lands, such as National Parks and National Forests, contribute significantly to local economies by attracting outdoor enthusiasts who then purchase goods and services. Unfortunately the extent to which the economic benefits of public access scale to smaller properties is unclear. Throughout the Great Plains small wildlife management areas, waterfowl production areas, and private lands open to public use attracts thousands of hunters annually. While there is a presumed economic benefit, the extent of the benefits depends largely on the user. Through in-person interviews of hunters in Nebraska we gathered information about regional use of publicly accessible lands. Hunting trips vary across distinct regions within Nebraska and by hunting seasons, ultimately influencing the economic benefit of publicly accessible lands. With this information, communities and wildlife managers may be better equipped to provide hunters with resources during popular hunting times.

The carryover effects of hunting pressure on Ring-necked Pheasant nest site selection and egg volume

Adela C. Annis, *US Geological Survey, Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska-Lincoln*
Joseph J. Fontaine, *USGeological Survey, Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska-Lincoln*

Southwest Nebraska is a popular destination for resident and non-resident upland gamebird hunters. High hunting pressure occurs on Conservation Reserve Program (CRP) properties enrolled in the Nebraska Game and Parks Commission's Open Fields in Water Program for public hunting. Female Ring-necked pheasants experience a high degree of hunting pressure on CRP public access properties verses low pressure on most private CRP fields. State and local

agencies were interested in improving the population and researchers began to study the carryover effects of stress on female pheasants to help understand if hunting pressure had a negative influence on nesting behavior. Our research suggests that the carryover effects of high hunting pressure may influence nest site selection and egg volume. This may have implications for managing popular public access properties to maintain sustainable populations of pheasants while providing public hunting opportunities.

Fish population monitoring in the headwaters of the Arkansas River gold medal fishery

JimBob Romero, *Colorado Mountain College, Natural Resources Management Timberline Field Institute*

Jacob Mohrmann, *Colorado Mountain College, Natural Resources Management Timberline Field Institute*

Greg Policky, *Colorado Parks and Wildlife*

Katy Warner, *Colorado Mountain College, Natural Resources Management Timberline Field Institute*

In early January, 2014, 102 miles of the Arkansas River became the longest stretch of Gold Medal fishery in the state of Colorado. This stretch of river represents nearly a third of the total gold medal waters in the state. The process of reclaiming the river from a legacy of acid mine drainage, mine pool blowouts, and toxic alluvial tailings took over 20-years to complete; and the process of monitoring the fish population, rebuilding habitat and sustaining large numbers of fish has taken equally as long. This success story of rebuilding a dead river to a world class fishery, and the monitoring efforts to document the progress, has been a monumental task. The educational and training opportunities that Colorado Parks and Wildlife provides to the students in the Natural Resource Management Program is a highlight for student technicians every summer. This poster will focus on Colorado Mountain College student involvement, as part of this long term monitoring effort.

Habitat characteristics and hibernation emergence of the federally endangered New Mexico Meadow Jumping Mouse in Southwestern Colorado

Jennifer L. Zahratka, *Ecosphere Environmental Services*

Scott A. Wait, *Colorado Parks and Wildlife*

In southern Colorado, USA, little is known about the federally endangered New Mexico meadow jumping mouse (Zapus hudsonius luteus; hereafter NMMJM) where it is known to occur. Only one scientific study documents a population of NMMJM in southern Colorado and provides a general description of its habitat (Jones 1999). This population is now considered extirpated and the USFWS (2014) reports only two other confirmed populations of NMMJM in Colorado since 2005. One of these populations occurs at Sambrito Wetland Area in southwestern Colorado where it was first documented in 2012. To support recovery of the NMMJM in Colorado, we investigated habitat associations and hibernation emergence patterns of the NMMJM population at Sambrito Wetland Area. We conducted live-trapping and

vegetation surveys in 2014 and 2015 and collected morphometric data from each NMMJM captured. We achieved good capture success compared to other published studies of NMMJM with at least one capture recorded on every trap night and multiple recaptures. The earliest emergence observed was May 21 for males and June 6-11 for females, suggesting a minimum 16-day hibernation emergence lag between the sexes. Our data indicate that grass (26-50%) and forb (6-25%) cover and horizontal cover (1 meter in height) are important habitat components for NMMJM and are consistent with previous studies. These habitat and hibernation emergence data contribute much-needed information for the protection and management of the Sambrito Wetland Area and other potential NMMJM populations across southern Colorado.

Mule deer migratory behavior: a comparison of the sexes

Patrick Rodgers, *US Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming*

Tony W. Mong, *Wyoming Game and Fish Department*

Matthew J. Kauffman, *US Geological Survey, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming*

Recent advancements in GPS and satellite collar technology allow researchers to better monitor and delineate migration corridors and behaviors of many ungulate species across the West. Based on this new fine-scale information, policy, protections and management efforts are being crafted to sustain these key corridors. Most recent migration studies have collected movement data by collaring females of the population, because of their importance to recruitment and population dynamics and because of difficulties collaring males. Although sexual segregation on summer range has been well documented, whether or not males and females of a population migrate separately is unknown .We are exploring this unknown component of ungulate migration to better understand population-level migration corridors and migratory behaviors of male mule deer. Our approach combines existing doe mule deer movement data with ongoing doe and buck mule deer GPS and satellite collar studies. From 2005 to 2009, 82 doe mule deer doe were GPS-collared in south-central Wyoming, and migration corridors were delineated based on that the resulting data. In 2016, we outfitted 29 mule deer bucks with satellite collars on the same winter range. During the 2016 spring migration period we observed a divergence from currently documented doe migration corridors by four of the collared bucks. These results suggest that mapping buck migration patterns may be necessary to ensure proper policy, protections and management of migrating mule deer. Once movement data has been collected, this study will provide a robust comparison of the timing, stopover use, and migration corridors of male and female mule deer in south-central Wyoming.