

2015 CCTWS Annual Meeting Abstracts

February 4-6, Grand Junction, Colorado

Plenary Session Abstracts:

Outdoor Recreation, the North American Model, and the Future of Wildlife Management

David Petersen, Sportsmen, Writer, Conservationist

Traditionally, recreation, primarily in the form of hunting and fishing, has been the financial lifeblood of state wildlife agencies. But with continued human population growth, an increasingly urban, virtual/abstract view of nature, the mechanization of outdoor recreation (OHVs, bicycles, etc.), and diminishing wildlife habitat, Colorado's outdoor culture is changing. Consequently, to insure our own financial future as well as to properly discharge our public obligation to maintain healthy, free-roaming wildlife populations for all Americans to enjoy via democratic access, wildlife agencies must change with the times. Yet bureaucratic inertia and lack of political will are holding us back. While Leopold's Land Ethic and TWS's own N.A. Model of Wildlife Conservation and Public Trust Doctrine clearly map the necessary way forward, caving to well-organized, well-funded recreational special interests is holding us back. In fact, wildlife and habitat agencies and the fish and wildlife they speak for are quite literally losing ground. In this way—via buckling to special-interest politicization at the legislative and agency decision-making levels, contemporary wildlife management is its own worst enemy. To turn the ship while we still can, the onus is on individual field-level wildlife scientists and managers to firmly and persistently speak the truth to power.

Resource Planning in Recreation Management Decision Making

Jeff Thompson, Colorado Parks and Wildlife

The inclusion of information and scientific knowledge is often the most resource and time intensive component of the management decision process. This reality can lead to decisions being made without the best available information being considered in management decisions. The CPW Resource Stewardship Program exists to “promote sustainable outdoor recreation settings, while improving and sustaining the ecological, scenic, and scientific assets in and around State Park lands.” This goal is attained through proactive data collection and the application of this resource data to management decisions on State Park properties. This presentation will highlight some of the procedures the Resource Stewardship Program uses while discussing the topics of why data is collected, what sources are available for data acquisition, and how this information is applied to the management decision process. Included will be examples of outcomes of data application in the decision process.

Outsmarting Management: Elk Responses to Land Management and Vehicle Use

Douglas S. Ouren, United States Geological Survey (USGS), Fort Collins Science Center

Wildlife species can adapt and optimize their responses to management, withdrawing its intended effects. We demonstrated this phenomenon for a hunted population of female elk, in the Upper Gunnison Basin of Colorado, that is exposed to a multiple-use landscape. Here management is applied disproportionately but in a distinct spatial and temporal pattern according to three jurisdictions: those managed for public use, including elk hunting; national park lands that offer a sanctuary from hunting; and privately owned lands that offer novel forage resources and relatively low hunting pressure. We collected habitat use data from 31 female elk fit with GPS collars to estimate their seasonal resource selection and habitat use patterns. We simultaneously monitored traffic volume on off-highway roads and synchronized elk habitat use and traffic volume data. Because our resource selection analyses offered limited utility for estimating temporal effects, we complemented resource selection analyses with a temporally driven regression analysis focused on the distance that elk were displaced from roads and continuous traffic count data. Elk selected for privately owned agricultural lands and were relatively uninfluenced by roads during the calving season. In contrast, elk were able to reduce the effect of managed hunting by displacing themselves from roads, traffic, and areas of increased hunting pressure during the hunting season. In the absence of population controls beyond hunting (e.g., culling) or mitigations that restrict animal use (e.g., fencing), temporally and spatially dynamic management prescriptions may serve as an effective option to manage how elk use this landscape. In addition, our results demonstrate that elk can rapidly adapt their habitat use and selection behaviours and we recommend that animal use and selection studies place greater emphasis on temporal effects.

Colorado Lynx and Winter Recreation Study

John Squires, U.S. Forest Service, Rocky Mountain Research Station

Elizabeth Roberts, U.S. Forest Service, White River National Forest

Jake Ivan, Colorado Parks and Wildlife

Understanding how Canada lynx respond to motorized and non-motorized winter recreation is central to the species' management in Colorado. This understanding requires that we determine how winter recreationists and lynx respond to habitat characteristics and other environmental covariates. From 2010-2014, we instrumented lynx (N=21) with GPS collars in areas of frequent winter recreation, including Vail Pass Recreation Area, Leadville area, and the San Juan Mountains. Concurrently, we distributed handheld GPS units to winter recreationists to document their spatial movements and resource-use across the same lynx study areas. Winter recreationists were receptive to study participation (>90% acceptance rate) regardless of recreation-use type (Snowmobiles – 693 tracks; Hybrid (backcountry skiers using snowmobiles for access) – 368 tracks; Backcountry skiers/snowboarders – 1208 tracks). We present resource-selection functions of winter recreationists based on their spatial use. We will relate these recreation use-surfaces to lynx movements and resource-use through an analysis that is currently ongoing. Ancillary to determining the lynx/recreation relationship, we documented instrumented lynx crossing 2-lane highways 536 times. We used this data to develop a predictive model of lynx highway crossing behavior, given that highways may reduce population connectivity of lynx in Colorado.

Temporal and Spatial Changes in Golden Eagle Reproduction in Relation to Increased Off Highway Vehicle Activity

Karen Steenhof, Boise State University, Department of Biological Sciences

N. Kochert, United States Geological Survey (USGS), Forest and Rangeland Ecosystem Science Center

Jessi L. Brown, University of Nevada, Reno, Academy for the Environment

We used 40 years of data on golden eagles (*Aquila chrysaetos*) nesting in southwestern Idaho, USA, to assess whether the proportion of territories and pairs producing young has changed over time, and whether territories in areas where off highway vehicle (OHV) use has increased significantly were less likely to be productive than those in areas that continued to have little or no motorized recreation. The proportion of territories that produced young was similar across southwestern Idaho from the late 1960s to 1999. After a dramatic increase in OHV use from 1999 to 2009, occupancy and success of territories in close proximity to recreational trails and parking areas declined, and the proportion of these territories producing young differed significantly from territories not impacted by OHVs. We could not pinpoint which types of motorized activity are most disturbing, nor could we identify disturbance thresholds at which eagles abandon their eggs, their young, and finally their territory. Timing, proximity, duration, and frequency of disturbance could all play a role.

Balancing Public Access with Species Protection: Current Knowledge and Research Needs

Sarah Reed, North America Program of the Wildlife Conservation Society and Colorado State University, Department of Fish, Wildlife, and Conservation Biology

The majority of protected areas globally (94%) and in North America (99%) permit public access for nature-based tourism and outdoor recreation. Although trade-offs between extractive and consumptive land uses and species protection are well known, outdoor recreation is often assumed to be compatible with biodiversity conservation. However, as visitation to protected areas and participation in nature-based activities increase rapidly around the world, a growing body of research demonstrates that recreation can negatively impact plant and animal communities. I will discuss key findings of a global systematic review of the effects of recreation on wildlife, suggest priorities for future research, and highlight two new field projects that are addressing the challenges and trade-offs of balancing nature-based tourism with wildlife conservation in protected areas.

Ties that Bind: Political and Policy Links between Outdoor Recreation and Land Conservation Pose Management and Biodiversity Protection Challenges

Sarah Thomas, University of Colorado, Center of the American West

Public demand for outdoor recreation has proved a major impetus for land protection in the United States, and key conservation policies, management programs, and funding initiatives are aimed at ensuring public access to protected areas. Yet, as outdoor recreation participation steadily increases, it may undermine the conservation goals of public lands; research shows that recreation activities can negatively affect species, habitats, and ecosystem processes. This talk will explore the entrenched political and policy ties between outdoor recreation and land protection, present findings on the critical challenges outdoor recreation poses to land managers, and propose management strategies that can help to minimize recreation activities' potential ecological damage.

Managing Human-Carnivore Conflict in the 21st Century: Old Methods, New Ideas, and the Need for Rigor and Reliable Information

Stewart Breck, United States Department of Agriculture (USDA), National Wildlife Research Center

This is an incredible time to be a carnivore ecologist with growing and expanding carnivore populations, a growing and expanding human population, and unprecedented societal tolerance for coexisting with carnivores. I will share my perspective on carnivore management exploring both lethal and non-lethal options and considerations for the future. My perspective is based on my job requirement of developing non-lethal methods for predator management working for an agency that is regularly criticized for its use of lethal techniques. I will draw on my experiences working with wolves, black bears, and coyotes in systems that are agriculturally based and urban based. I will highlight topics that I think are critical for moving forward including a greater need for understanding of carnivore behavior, human behavior, and most importantly more rigor in how we measure and manage human-carnivore conflict.

Integrating Social Science to Understand Human-Coyote Conflict in Urban Denver

Andrew Don Carlos, Colorado State University, Department of Human Dimensions of Natural Resources

Wildlife managers across the globe are increasingly facing the unique challenge of managing human-wildlife conflict (HWC) in urbanized landscapes. Developing effective HWC solutions begins with an assessment of the underlying causes of conflict as well as the potential constraints to successful mitigation. In the case of urban HWC, human thought and behavior often act as key drivers of conflict occurrence and key factors in the ability of wildlife managers to address the problem in a comprehensive manner. Achieving sustained reductions in the extent and severity of urban HWC will thus require the integration of the social sciences to provide a better understanding of the human factors which interact with biological and ecological forces in a complex system. This presentation will look at conflict between people and coyotes (*Canis latrans*) in the Denver Metropolitan Area as a case example that illustrates such an integrative approach to informing HWC management. A survey of residents (n=4,129) from 60 Metro Denver neighborhoods with varying degrees of reported coyote conflict was conducted to assess public attitudes toward coyotes, support for various urban coyote management strategies, and engagement in behaviors related to coyote conflict. Results demonstrate how social science information can complement biological and ecological knowledge about a conflict-prone wildlife species and enhance management at various scales. Conclusions drawn from this effort shed light on the opportunities and challenges associated with a multi-disciplinary approach to understanding contemporary wildlife management problems.

Community Engagement in HWC: Using Citizen Science and Community Level Hazing to Manage Coyote Conflict in Urban Denver

Mary Ann Bonnell, Jefferson County Open Space

Two facets of the Denver Metro Area Coyote Study included direct community engagement. Coyote activity monitoring is considered a best practice for successful urban coyote management programs (Baker 2007). The Coyote Watch Citizen Science program provided local residents with the opportunity to actively participate in coyote activity reporting in their community. Hazing (aversive conditioning) is widely accepted by both residents and managers as a tool for reducing human-coyote conflict in urban environments (DMA Coyote HD Survey 2013, DMA Coyote Manager Inventory 2012). Community-based Coyote Hazing Trials asked park users to engage in the active hazing of coyotes in their local parks. This talk provides an overview of each program as well as a look at specific outcomes and lessons learned from each for future improvements.

Methods to Understand Human-Wildlife Conflicts in the 21st Century: An Approach to Include Wildlife and People

Stacy Lischka, Colorado Parks and Wildlife

Mitigating negative effects of human-wildlife conflict is critical, but focusing only on ecological components of the system limits our ability to do so. Incorporating both social and ecological factors in conflict research is essential but rarely attempted in a truly integrated way. We argue that challenges in defining research questions, developing common language, and addressing spatial and temporal scales have limited such a holistic approach. We propose a social-ecological systems model to guide future research and aid in understanding and managing human-wildlife conflict. This model, based on ecological and social science theory and grounded in applied experience, advances understanding because it identifies feedback mechanisms between human and animal behavior that perpetuate interactions and challenge management. We apply this model to an applied study of human-black bear conflict in Durango, Colorado to identify the benefits and challenges of integrating ecological and social inquiry.

Technical Session Abstracts:

Do You Know Where Your Habitat Stamp Has Been Lately? The Colorado Wildlife Protection Program – History and Accomplishments

Brian Holmes, Colorado Parks and Wildlife

Matt Lucia, Colorado Parks and Wildlife

The Colorado Habitat Stamp was created by the Colorado legislature in 2006, for the purpose of generating funds through a surcharge on hunting and fishing licenses that can be used to conserve and protect important wildlife habitat and/or secure public access for wildlife-related recreation. While the program has undergone several changes since its inception, the underlying objectives have remained the same and include prioritization of 1) protecting big game winter range and migration corridors; 2) acquiring public access to wildlife-related recreation, including hunting, fishing, and wildlife viewing; 3) protecting habitat for species of concern; and 4) preserving the diversity of wildlife enjoyed by Coloradans. This presentation will review the history of the program and accomplishments to date with specific examples of properties conserved and acquired, distribution of protected properties across the state, access agreements that increase recreational opportunities, and additional funding that has been leveraged by the program. To date, over 200,000 acres have been protected and access has been gained on over 100,000 acres through the Colorado Wildlife Habitat Protection Program (CWHPP).

Gunnison Sage-Grouse: Collaboration and Opportunity

Noreen Walsh, U.S. Fish and Wildlife Service, Mountain-Prairie Region

On Nov. 12, 2014, the U.S. Fish and Wildlife Service (Service) announced it would list the Gunnison sage-grouse as a threatened species under the Endangered Species Act (ESA). The Service's decision was based on the species' overall small population size, the precarious status of six satellite populations, and long-term threats primarily to those satellite populations. Colorado Parks and Wildlife, Gunnison County and others have done significant and effective work to protect the core population. Why, then, was the species listed?

The Gunnison sage-grouse status review provides an opportunity to explore the Service's desire to secure durable and lasting conservation through collaboration, which is sometimes challenging in the face of timelines driven by ESA deadlines and litigation. Mountain-Prairie Regional Director Noreen Walsh will explain the Service's listing rationale in the context of conservation accomplishments to date in the basin; their foundation in collaboration, and their impact on the listing decision. She will explore challenges to the collaborative conservation model posed by litigation. The effort to conserve the Bi-State population of the greater sage-grouse may provide a useful comparison in describing the challenges and opportunities on the Gunnison sage-grouse road to recovery and the return of the species to state management. Lastly, Noreen will address efforts undertaken by many conservation partners to conserve greater sage-grouse, and discuss those in the context of the Gunnison sage-grouse decision.

Shifting Perceptions of Risk and Reward: Dynamic Selection for Human Development by Black Bears

Heather E. Johnson, Colorado Parks and Wildlife

Stewart W. Breck, United States Department of Agriculture (USDA), National Wildlife Research Center

Sharon Baruch-Mordo, The Nature Conservancy

David L. Lewis, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Carl W. Lackey, Nevada Department of Wildlife

Kenneth R. Wilson, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

John Broderick, Colorado Parks and Wildlife

Julie S. Mao, Colorado Parks and Wildlife

Jon P. Beckmann, Wildlife Conservation Society

As landscapes across the globe experience increasing human development, it is critical to identify the behavioral responses of wildlife to this change given associated shifts in resource availability and risk. This is particularly important for large carnivores as their interactions with people are often a source of conflict, which can impede conservation efforts and require extensive management. To examine the adaptations of a large carnivore to benefits and risks associated with human development we investigated black bear behavior from three systems in the United States. Our objectives were to identify temporal patterns of selection for development within and across years, compare spatial patterns of selection for development across systems, and examine individual attributes associated with increased selection for development. Using mixed effects resource selection models we found that bear selection for development was highly dynamic as the benefits and risks of foraging in human-dominated landscapes varied as a function of natural food conditions, physiological state, and experience with anthropogenic resources. Bears increased their use of development in years when natural foods were scarce, throughout the summer-fall, as they aged, and as a function of gender, with males exhibiting greater use of development. While patterns were similar across systems, bears at sites with poorer quality habitat selected development more consistently than bears at sites with higher quality habitat. Black bears appear to use development largely for food subsidy, suggesting that conflicts with bears, and potentially other large-carnivores, will increase when the physiological demand for resources outweighs risks associated with human activity.

Impacts of Bark Beetle Epidemics on Mammals in Colorado

Jake Ivan, Colorado Parks and Wildlife

Amy Seglund, Colorado Parks and Wildlife

Rick Truex, U.S. Forest Service, Wildlife Ecology Program

Mountain pine beetle (*Dendroctonus ponderosae*) and spruce beetle (*Dendroctonus rufipennis*) infestations have reached epidemic levels in Colorado, impacting approximately 3.7 million acres since the initial outbreak in 1996. Though bark beetles are native to Colorado and periodic infestations are considered a natural ecological process, the geographic scale of their impact and simultaneous infestation within multiple forest systems has never been observed. This historic outbreak is having significant impacts on composition and structure of forest stands that will propagate for decades into the future. The widespread mortality of forested systems in Colorado is likely to have a dramatic, but poorly understood effect on wildlife species that depend on these habitats. We used occupancy estimation to determine how use of the landscape by mammals and breeding birds changes after bark beetle infestation. We deployed remote cameras at 300 randomly selected plots in Engelmann spruce (*Picea engelmanni*) – subalpine fir (*Abies lasiocarpa*) and lodgepole pine (*Pinus contorta*) forests throughout the state. Our sampling covered a variety of conditions including areas that have not yet been infested by beetles, areas that were infested only recently, and those that were infested up to 12 years ago. Preliminary results indicate that some species, such as snowshoe hares (*Lepus americanus*) and red squirrels (*Tamiasciurus hudsonicus*), decrease their use of an area after bark beetles move through. Other species, such as American marten (*Martes americana*), increase their use of such areas, and still others show little or no response.

Using GPS Transmitters to Test Lek-Based Monitoring and Management for Greater Sage-Grouse in Northwestern Colorado

Brett Walker, Colorado Parks and Wildlife

State wildlife agencies rely on lek-based monitoring and management strategies for greater sage-grouse (*Centrocercus urophasianus*), but such strategies require field testing across sage-grouse populations. For example, circular buffers around lek locations are often used to identify, prioritize, and protect important sage-grouse habitats, but space use by birds and the effectiveness of lek buffers may differ among populations. I tracked male greater sage-grouse with solar GPS PTT transmitters in two study areas in northwestern Colorado with oil and gas development between 2011-2014 to test the effectiveness of lek buffers at capturing seasonal space use. Tracking GPS males during the breeding season identified numerous new lek locations and documented both inter-lek and long-distance movements. The lek buffer radius required to capture different proportions of male use locations differed substantially among seasons and between populations. Incorporating previously unknown lek locations into management increased the effectiveness of lek buffers at capturing breeding use locations and reduced the buffer size required to capture those locations. I also discuss other implications of data gathered from tracking GPS-marked sage-grouse for monitoring and management.

Investigating the Direct and Indirect Effects of Greenback Cutthroat Trout on Boreal Toad Recruitment

Wendy E. Lanier, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Larissa L. Bailey, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Kevin R. Bestgen, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Amphibian populations are in great decline worldwide. The boreal toad, *Anaxyrus boreas boreas*, is no exception. Much of the decline in its populations can be attributed to the chytrid fungus, *Batrachochytrium dendrobatidis*. However, there are some declining populations with little to no evidence of chytrid. One such population breeds at Spruce Lake, a historically fishless lake in Rocky Mountain National Park, Colorado, where greenback cutthroat trout, *Oncorhynchus clarkii stomias*, were introduced from 1990-1992. Salmonids have been shown to alter ecosystems where they have been introduced yet toads are not typically among species that show declines associated with these introductions. Despite being unpalatable to many predators, boreal toads might be negatively impacted by trout in other ways, thus explaining these enigmatic declines. Here we present the results from a laboratory experiment in which we repeatedly exposed boreal toad tadpoles to greenback cutthroat trout. The tadpoles came from two sources: eggs bred in the wild and eggs bred in a hatchery. We observed the effects of the trout on tadpole survival, growth, and development. Our results indicate that trout exposure can markedly reduce boreal toad tadpole survival, even though few individuals were actually consumed by the trout. Given the current unprecedented declines in amphibian populations and the continued introduction of salmonids for recreation as well as conservation, better understanding of the interactions of salmonids and amphibians will help inform management decisions of both these taxa.

Long-Term Impacts of Chaining on Bird Communities in the Piceance Basin of Northwest Colorado

Travis Gallo, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Liba Pejchar, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

A large percentage of the earth's surface has been disarranged through land management practices. Pinyon-juniper (P-J) woodlands of the western U.S. have been the objects of efforts to covert woodlands into grazing lands for livestock and big game for decades. Tree-reduction efforts involving chaining have been applied to a large amount of land in P-J ecosystems, and future tree-reduction efforts are expected to increase as managers are tasked with multiple objectives, including fire prevention and wildlife habitat. We investigated the long-term impacts of chaining on non-target bird communities in the Piceance Basin of northwest Colorado. We found that historic chaining sites were dominated by fewer species than reference sites, and those dominate species represented birds that preferred shrubland habitats – e.g. Brewer's sparrow – whereas reference sites were dominated by species preferring woodland habitats – e.g. spotted towhee. We also found that ground gleaners were more likely to use historic chaining sites than reference sites; and bark gleaners, air salliers, shrub gleaners and upper canopy gleaners were more likely to be found in reference sites over historic chaining sites. Wildlife species provide ecological services and can play an important role in structuring plant communities. Therefore, understanding the long-term effects of tree reduction efforts on non-targeted wildlife species is both ecologically interesting and has important conservation implications.

Seeding, Soil Surface, and Brush Mulch Effects on Plant Community Development of Disturbed Mountain Sagebrush Sites

Danielle B. Johnston, Colorado Parks and Wildlife

High-precipitation mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) sites are resilient to disturbances. Even so, restored areas may not resemble nearby undisturbed areas; post-restoration sites are often overly dominated by seeded grasses. At 4 disturbed mountain big sagebrush sites (2342m - 2676m) in the Piceance Basin of northwest Colorado, I compared unseeded plots to plots seeded with native species at 17.8 (kg/ha) PLS (60% of which was grass). Seeded/unseeded treatments were crossed with 2 additional treatments designed to improve soil heterogeneity, foster germination, and control exotic species: roughening the soil surface with pothole-sized holes, and applying brush mulch at .024 m³/m². By 5 years post-treatment, the annual forbs which initially dominated unseeded plots had declined to 10% cover. Unseeded plots had 23.5% grass cover (about 2/3 of that of seeded plots), 6.8% forb cover (about 1/3 that of seeded plots), and 27% shrub cover (nearly double that of seeded plots; $p < 0.0001$). The brush treatment reduced annual forb cover, increased perennial grass cover, increased perennial forb cover, and increased sagebrush by 10-25% ($p < 0.03$). Cheatgrass (*Bromus tectorum*) became established in unseeded plots at the lowest elevation site. There, the rough surface treatment reduced cheatgrass cover from 13.0% to 2.5% ($p < 0.0001$). Grass-heavy seed mixes slow the recovery of sagebrush and may not be necessary at high elevation sites. Rapid plant community recovery can be promoted by brush mulching, and a rough soil surface may help minimize risk of invasion by cheatgrass.

Refining Scales of Analysis for Resource Selection Functions to Better Manage a Greater Sage-Grouse Population in North Park, Colorado

Mindy B. Rice, Colorado Parks and Wildlife

Liza G. Rossi, Colorado Parks and Wildlife

Anthony D. Apa, Colorado Parks and Wildlife

Range-wide declines of greater sage-grouse (*Centrocercus urophasianus*, GRSG) and recent energy development within sagebrush habitat has led to concern for conservation of greater sage-grouse populations across Colorado, including in North Park, which supports approximately 20% of the state's GRSG. Models depicting seasonal variations in habitat use by GRSG can provide important information for biologists and managers. These models have been constructed at the statewide scale, but have not been completed specifically for the North Park population. Furthermore, these models were based on data that did not come from North Park and only included vegetation variables. The large scale predictions showed that nearly the entire sagebrush basin in North Park basin was important habitat, and failed to differentiate among habitats within Park occupied habitat for the GRSG. GRSG habitat use is known to be influenced by both landscape-scale and local-scale factors.

We collected almost 4,000 locations on 117 radio-marked female GRSG from April 2010-February 2012 in North Park in an effort to refine the statewide models to a local scale. These locations were used to map breeding, winter, and summer habitat using logistic regression in program R. Variables were chosen based on vegetation and topography. All three seasons indicate a high probability of GRSG in areas where they currently reside. The breeding and winter models tended to be similar, and predicted high probability of use in large expanses of sagebrush and little to no probability in riparian areas. The summer model predicted greater use along the edge of riparian areas and a more disjunct high probability surface.

The models developed here for North Park reduced the amount of priority habitat predicted in the range-wide GRSG seasonal models by 37%. More importantly, the local scale models differentiated habitat within the basin population, which was lacking in the range-wide seasonal models. Utilizing both scales of seasonal models provides a more complete picture of habitat use by the North GRSG Park population and provides multiple products for effective management.

Poster Abstracts:

Sage-Grouse as an Umbrella Species in Northwestern Colorado

Jennifer Timmer, Colorado State University, Department of Fish, Wildlife, and Conservation Biology
Cameron Aldridge, Colorado State University, Department of Fish, Wildlife, and Conservation Biology
Retta Bruegger, Colorado State University, Department of Fish, Wildlife, and Conservation Biology
Maria Fernandez-Gimenez, Colorado State University, Department of Fish, Wildlife, and Conservation Biology
Crystal Tipton, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Reduction in sagebrush rangelands has resulted in sagebrush avifauna population declines across western North America, triggering a need to better understand relationships between environmental characteristics and avifauna resource needs. These relationships can inform land use planning and management decisions, which are necessary for species of conservation concern, such as sage-grouse, whose range includes privately and publicly-managed land. Sage-grouse may act as an umbrella species to manage for multiple species that rely entirely or partially on sagebrush rangelands, but the efficacy of such approaches is often assumed. Sage-grouse should be an effective umbrella species because they have a large range that overlaps with many other species, they are fairly sensitive to anthropogenic activity, and their biology is well-known. However, previous work to identify sage-grouse as an umbrella species has used broad patterns at coarse resolutions rather than a multi-scale approach. Species specific studies have shown that sage-grouse and sagebrush passerines, such as Brewer's sparrows, respond to habitat characteristics and disturbance at multiple scales. I surveyed greater sage-grouse and sagebrush songbird habitat use on private and public rangelands in northwestern Colorado in order to 1) create generalized linear models of bird use related to multi-scaled environmental features, 2) and determine the amount of habitat overlap between sage-grouse and three sagebrush-obligate songbirds (Brewer's sparrow, sage thrasher, and sage sparrow). These objectives were part of a larger project to model wildlife habitat and use by sagebrush avifauna as an ecosystem service in state-and-transition model framework.

Application of the Bighorn Sheep Risk of Contact Tool and Best Available Science to a Domestic Sheep Allotment Analysis Process: the Fisher-Ivy/Goose Allotment, Rio Grande National Forest.

Randal W. Ghormley, U.S. Forest Service, Rio Grande National Forest
Dale Gomez, U.S. Forest Service, Rio Grande National Forest

The need to maintain effective separation between domestic sheep and bighorn sheep on free range conditions is widely recognized as the most prudent action that can be taken to reduce the potential for interspecies disease transmission. Current Forest Service direction to achieve these objectives is to utilize a risk assessment process where management objectives include maintenance or enhancement of bighorn sheep populations. Historical accounts suggest that Rocky Mountain bighorn sheep were common on the Rio Grande National Forest during early settlement period of the mid- to late 1800's. As in many areas of the western United States, these herds were largely decimated by the early 1900s. Currently, 11 bighorn sheep herds containing an estimated 1,100 individuals occur or partially occur on the Forest with ample unoccupied habitat available. Domestic sheep grazing has also been an important local cultural and economic activity since the early settlement period. Domestic sheep numbers peaked at about 245,000 during the 1920's, however the Forest still supports approximately 11,500 sheep on roughly 26 different allotments. Some of these allotments occur in proximity to or even overlap known or suspected bighorn sheep core herd range and/or summer source habitat. This poster presentation displays aspects of our recent quantitative analysis involving the Fisher-Ivy/Goose Allotment, including graphs and figures associated with our use of the recently produced Bighorn Sheep Risk of Contact Tool to help inform the Risk Analysis and decision. Our use of the Risk of Contact Tool is a first for the Forest Service Rocky Mountain Region, and we display why we suggest its use and application to be representative of the best available science in informing this issue on our larger landscape.

Potential Effects of Natural Gas Development on Neonatal Mule Deer Survival

Mark E. Peterson, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Charles R. Anderson, Jr., Colorado Parks and Wildlife

Paul F. Doherty, Jr., Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Extensive natural gas development on public lands has elevated concern among stakeholders, wildlife managers, and researchers about the impacts on mule deer (*Odocoileus hemionus*) populations and their habitat. Understanding neonatal mule deer survival and cause-specific mortality is helpful to comprehend mule deer population dynamics, especially where natural gas development disturbances are occurring. The intensity of disturbance from development may be directly negatively correlated with neonate survival, or indirectly correlated through changes to habitat. However, no published studies have quantified the effects of natural gas development disturbances and consequent habitat conversion on neonatal mule deer survival and cause-specific mortality. Estimates of survival and cause-specific mortality were derived from a sample of neonates captured and radio-collared in 2012, 2013, and 2014 using vaginal implant transmitters inserted in adult females. Estimates of survival and cause-specific mortality were determined in energy developed and undeveloped areas in the Piceance Basin, Meeker, CO. In 2012, 2013, and 2014 survival estimates in the developed area were 0.35 (SE = 0.06), 0.29 (SE = 0.08), and 0.60 (SE = 0.07), respectively. In 2012, 2013, and 2014 survival estimates in the undeveloped area were 0.50 (SE = 0.10), 0.45 (SE = 0.08), and 0.67 (SE = 0.19), respectively. In 2012 - 2014, predation was the leading cause of mortality and accounted for 0.43 (SD = 0.14) of mortalities in the developed area and 0.37 (SD = 0.16) in the undeveloped area. Overall, our goal will be to provide results promoting improved energy development mitigation and wildlife management practices.

Monitoring of “*Mustela nigripes*” (Black-Footed Ferret) at SoapStone Prairie Natural Area Using a Remote Camera System to Capture Images

Tyler Greenly, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Hayden Akers, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

The black-footed ferret “*Mustela nigripes*” is the most endangered mammal in the United States, with the entire world population stemming from just 18 specimens. By the time these 18 individuals were captured the entire Colorado population of ferrets was long gone. However, in recent years scientists have been reintroducing ferrets at SoapStone Prairie Natural Area. It is the goal of The Wildlife Society Camera Project to help monitor the movements and activities of the ferrets using remote sensing camera's, as well as document the other organisms of this last natural grassland. In the future TWSCP hopes to see a rise in the number of ferret sighting, an indication that the population is growing and self reproducing.

Hands-on Environmental Education as an Effective Tool for Teaching Middle School Students

Savanna Smith, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Hayden Akers, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Samuel Peterson, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

Environmental education is an especially useful and necessary tool for connecting our youth with the outdoors and producing youth who care about the environment. As our society becomes more technology dependent, participation and interest in the outdoors has decreased. In this study we worked with a local 6th grade science teacher to integrate the information from our wildlife cameras with the information the students were learning in their ecology unit. The students used our photo data to create food webs, ask a research question (Which kind of animals are most common at each type of habitat?), and eventually graph their results. In addition, a voluntary field trip was organized to give the students the opportunity to directly participate in the field methods used and apply the knowledge that they had learned in class. We found that this method of teaching was very effective in garnering the student's interest in the subject matter and improving their overall understanding of the material. We hope to build off the success of this project and expand this program to many other classrooms in the area, allowing us to benefit a wider range of students.

Assessing Two Decades of Vegetation Change in Sagebrush Habitats of the Upper Gunnison Basin, Colorado

Kitt Haven, Western State Colorado University

Jonathan Coop, Western State Colorado University

Jessie Dodge, Western State Colorado University

Dan Piquette, Western State Colorado University

Across the western US, sagebrush landscapes have been altered by invasive species, changing fire regimes, land use, and climate. In the Upper Gunnison Basin, these landscapes form critical habitat for the imperiled Gunnison Sage-grouse, winter big-game range, and ranching. The purpose of our research was to assess patterns of recent change by re-measuring a series of vegetation transects originally sampled as part of a habitat inventory in the 1990's. During the summer of 2014, we located and re-measured over 100 transects stratified across the entire basin. We found significant declines in live shrub canopy cover (from 42.5% to 34.0%; $P < 0.001$) and increases in dead shrub cover (9.3% to 16.0%; $P < 0.001$). Sagebrush (*Artemisia nova* and subspecies of *A. tridentata*) showed pronounced dieback, decreasing from 29.4 % to 23.0% ($P < 0.001$). Rabbitbrush (*Chrysothamnus* spp.) exhibited a minor, marginally significant increase, from 2.7% to 3.4% ($P = 0.05$).

Declines in shrub cover were widespread and not clearly related to elevation or topographic variation. This pattern of basin-scale change is consistent with impacts of regional climate variability; anecdotal evidence suggests that dieback was initiated during the exceptionally warm and dry year of 2002. Further analysis of relationships between field data and a time series of satellite imagery (NDVI) and interpolated climate data (PRISM) will be used to explore the possible role of climate in sagebrush decline. These findings can also be of use in forecasting possible future trends for diminishing sagebrush habitats and the species that depend on them.

Reproductive Biology of the Unaweep Canyon Bluebird Trail

Susan M. Longest, Colorado Mesa University

Bob Wilson, North American Bluebird Society and Grand Valley Audubon Society

The Unaweep Canyon Mountain Bluebird Trail was started by Bob Wilson in 1999 and has since provided essential nesting habitat for hundreds of mountain bluebirds and ash-throated flycatchers. The reproductive success from nest boxes along this trail were analyzed across the 15-year timespan for both mountain bluebirds and ash-throated flycatchers. Changes in the lay date for both species were analyzed, as well as relationships between reproductive success and temperature. These results provide crucial insight into the success of this long-term project monitoring the reproductive behavior of mountain bluebirds, as well as the adaptability of these birds to environmental factors affecting their reproduction.

First Asia Conservation Expo (ACE)

Hannah Wherry, Colorado State University, Department of Fish, Wildlife, and Conservation Biology

The First Asia Conservation Expo (ACE) is an initiative created by students to bring together key experts to educate the community about the importance of conservation. This global experience will include organizations from around the world to cross fertilize ideas, share current conflicts, and provide opportunities for students to become involved in saving endangered species. Hosting the expo in Asia will provide a much larger opportunity to make an impact on upcoming generations with education about current issues as well as raise awareness. Animals include: Great White Sharks, Manta Rays, Pandas, Rhinos, Elephants, Big Cats, and Sloth Bears. Participants will network with wildlife organizations from around the globe and learn about the many issues that are affecting endangered species. The two-day expo will include both a wildlife seminar and a photography exposition. Students who enter their wildlife photos will have their photos beautifully displayed for the audience, as well as have an opportunity to win amazing prizes. A thousand mile journey starts with one step, help make an impact and save endangered species.