2014 Colorado Chapter of TWS Annual Meeting Abstracts

February 5-7, 2014
Hilton Hotel - Fort Collins, CO

Thursday Morning Plenary Abstracts (in order of their presentation):

"Crawling, Running, Flying…Wildlife Migration and Movement in Colorado and Beyond"

Conservation's unwieldy path — big animals in an increasingly peopled world

Joel Berger, John J. Craighead Chair and Professor of Wildlife Conservation, University of Montana, and Wildlife Conservation Society

The world's landscapes reflect amazing diversity – hot and tropical, cold and non-peopled, temperate and increasingly peopled. Some 95% of the world's humans live below 1000 meters. It is at these low elevations where biodiversity is most challenged although high elevation sites certainly have their own impediments. Moving across a gradient of human density and extreme environments I will use three vignettes to portray the increasingly complex interactions between humans and wildlife while offering a modicum of hope. 1) In Arctic Alaska, where climate might logically be expected as a primary driver of muskoxen population dynamics, it is the indirect effects of humans that may be playing a larger (proximate) role. 2) In Central Asia, endemic wildlife including iconic wild yak, saiga, snow leopards, and chiru from the Tibetan Plateau to the Gobi Desert live in areas where human densities are among the lowest on the planet. Twin strategies to assure population persistence include the protection of large areas and connectivity across diverse lands with natural bottlenecks. Nevertheless, despite strong protection from poaching, populations are being exploited indirectly through interactions that involve western cultural preferences for cashmere steeped in the multi-billion dollar garment industry. Herein is the modern challenge. 3) In the comparatively more peopled American West, pronghorn are an ecological surrogate of Asia's saiga. Pronghorn also maintain the longest migrations for a terrestrial mammal between Canada and Tierra del Fuego. During migrations they confront fragmented landscapes, suburban expansion, and energy development. The extent to which on-the-ground progress addresses these three issues is the topic of this presentation.

Connectivity and wildlife conservation in urbanizing landscapes

Kevin Crooks, Department of Fish, Wildlife, and Conservation Biology, Colorado State University

The vast reach of humans and the resulting fragmentation of natural landscapes are of major concern to wildlife scientists, resource managers, and the general public. Habitat destruction has been targeted as a primary threat to biological diversity worldwide, and urbanization is a leading agent of fragmentation and cause of species endangerment. Mammalian carnivores may be particularly vulnerable to fragmentation because of their relatively large ranges, low numbers, and direct persecution by humans. Although landscape connectivity is a key for the persistence of carnivores - and many other species - the practice of preventing fragmentation and conserving connectivity in urban areas is not a simple matter. In this talk, I will discuss the benefits and challenges inherent in connectivity conservation in developing landscapes, focusing on mammalian predators. Case studies will include ongoing research to conserve connectivity at multiple scales, from local to global, to help guide strategic priorities for carnivore conservation.

Partnering for wildlife along the Spine of the Continent: the Western Wildway Network

Paige Singer, Conservation Biologist, Rocky Mountain Wild
Greg Costello, Executive Director, Wildlands Network

The ecological need for connectivity, and the presence of carnivores, originally championed decades ago by Michael Soule, Reed Noss and others has now been accepted by management agencies around the world. But acceptance is not implementation, and the challenge of ensuring core habitats, connectivity and carnivores on a continental scale remains. Wildlands Network is attempting to meet this challenge along the continental divide of North America through a collaborative network of conservation organizations, the Western Wildway Partners. The first joint effort of the partners was TrekWest, a 5000 mile trek in 2013 by Wildlands founder John Davis from Sonora Mexico to Fernie British Columbia. TrekWest was supported by the partners, and focused public attention on both challenges to connectivity and the conservation work of the partners in their respective regions. In 2014 the Partners will begin a joint effort to engage citizens, communities and state agencies in protecting 20 specific areas along the Continental Divide that are essential to continental scale connectivity. This collaborative work seeks to recruit new supporters, from private landowners to recreational business owners, community residents and tourists. It blends public outreach, education, citizen science, advocacy and policy and is intended to create a collective impact beyond what any one conservation organization could achieve.

Migration and other ways that amphibians move around

Dr. Erin Muths, Research Zoologist, Fort Collins Science Center, U.S. Geological Survey

Movements of amphibians across a landscape may seem small relative to larger animals, but their movements (migration to breeding sites, dispersal, and colonization) have biological import none the less. Population level connections can affect metapopulation dynamics and individual movement patterns can affect estimates of demographic parameters such as survival. My focus here will be on smaller scale movements with information from several species and habitats to provide some examples of amphibian movements and how they provide information for management and conservation.

How birds connect us locally, regionally and internationally

Tammy VerCauteren, Rocky Mountain Bird Observatory
Arvind Panjabi, Rocky Mountain Bird Observatory

Rocky Mountain Bird Observatory (RMBO) conserves birds and their habitats through science, education and stewardship working from the mountains of Montana to the tropics of Mexico. Through science we are advancing the understanding of bird populations to inform land management decisions. With education we are connecting people of all ages with nature and empowering individuals to make a difference. Our Stewardship team works with landowners to guide land management and restore habitats. We also work across borders to address full life cycles and take action where it's needed most. RMBO utilizes a variety of techniques to monitor and expand knowledge about migratory birds. We currently operate eight banding stations across Colorado and western Nebraska to investigate avian migratory routes, body condition, and sex ratios. Since 1988 we have captured 110,000 birds of 250 species and currently reach 5,000 youth annually. Stations complement our collaborative monitoring programs throughout the intermountain west and provide opportunities for youth to see scientists in action, learn about migration and discuss the challenges birds face. Geolocators are also helping unlock avian migration routes where satellite transmitter technology is still limiting and banding stations are impractical. Through use of geolocators we identified the previously unknown wintering grounds of the Black Swift, as well as migratory connectivity for western Tanagers breeding in Rocky Mountain National Park. Grassland birds are declining faster than other species and are a high conservation priority for conservation organizations, but in order to adequately conserve them we need to identify limiting factors throughout the full life cycle to understand what is driving declines. RMBO uses radio telemetry to track overwinter survival of grassland birds in the Chihuahuan Desert of Mexico. We have estimated that overwinter survival may be as low as 25%, highlighting

the need for conservation efforts on the wintering grounds. We are now evaluating if this trend is similar across species, regions and climatic scenarios over time. This information will help guide collaborative conservation strategies ensuring the right actions are taken and the best outcomes achieved for the conservation dollar.

Regional conservation planning for migratory birds: an example using Rocky Mountain Population sandhill cranes in the Intermountain West Joint Venture

Dr. Josh Vest, Science Coordinator, Intermountain West Joint Venture
Patrick Donnelly, Spatial Ecologist, Intermountain West Joint Venture
Dr. Jim Gammonley, Avian Research Biologist, Colorado Parks and Wildlife

Migratory birds often use a variety of habitats over their annual cycle and move across numerous political boundaries, necessitating cooperative partnerships at a variety of scales to plan and deliver conservation. For example, the Rocky Mountain Population (RMP) of sandhill cranes is managed through a cooperative management plan involving seven states and the U.S. Fish and Wildlife Service. This plan establishes a population objective, harvest strategy, and monitoring programs, and identifies habitat conservation issues and information needs for RMP sandhill cranes. Recently the Intermountain West Joint Venture (IWJV), a self-directed bird conservation partnership that operates across eleven western states, initiated a planning effort to address key information gaps which will lead to developing range-wide habitat conservation objectives for RMP sandhill cranes. This approach will, across all annual cycle events and relevant geographies: 1) define potential habitat extent, 2) characterize associated ecological drivers, catalog land-use practices, and landownership patterns, 3) measure and summarize the magnitude and distribution of near-term (e.g. 30 year) landscape change, and 4) identify potential landscape stressors by linking ecological and anthropogenic trends to changes in sandhill crane distribution and abundance. Results of this planning initiative will directly inform local-scale conservation efforts in Colorado.

Thursday Afternoon Plenary Abstracts for "Wildlife and Natural Gas Extraction in the Piceance Basin, Colorado: Impacts and Mitigation" are not available.

Please contact presenters directly for more information.

Technical Session Abstracts

Session 1:

Estimating cougar densities in Northeast Oregon using conservation detection dogs

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Estimating the densities of cougar (*Puma concolor*) is important for managing cougars and their prey but remains challenging due to cougar's elusive and solitary behavior. Traditional methods for estimating abundance and density of cougars require several years of extensive and expensive mark-recapture work. To evaluate a non-invasive, genetic capture-recapture method to estimate cougar population size, we conducted 4 surveys in each of nine 25-km^2 contiguous blocks using conservation detection dogs to collect scat over a 5-week sampling period in Northeast Oregon. We conducted DNA analysis on 249 scat samples from which we determined individual identification from 73 samples that represented 21 cougars (9 males and 12 females). We evaluated 4 methods to estimate cougar densities: closed population mark-recapture, CAPWIRE, multiple detections with Poisson (MDP), and spatially explicit capture recapture (SECR). Population estimates for cougars using our study area were 26 (95% CI = 22–35, 9 males and 17 females) from closed population mark-recapture models, 24 (95% CI = 21–30, 9 males and 15 females) from CAPWIRE, and 27 (95% CI = 24–42, 9 males, 18 females) from the MDP model. We accounted for the edge effect in density estimates caused by individuals whose home ranges included only a portion of the survey grid by buffering the study area using the mean home range radius of 8 cougars equipped with Global Positioning System collars on or near the study area. We estimated densities of 4.6 cougars/100 km^2 (CI = 3.8–8.3) for the closed population mark-recapture model, 4.8 cougars/100 km^2 (CI = 4.2–7.8) for the MDP model, 4.2 cougars/100 km^2 (CI = 3.3–5.3) for the CAPWIRE model, and 5.0 cougars/100 km2 (CI = 3.2–7.7) for the SECR model. Estimated densities were similar to previous estimates in Northeast Oregon generated from extensive multi-year mark-recapture methods. Our results suggest that estimating cougar densities using scat detection dogs could be feasible at a broader scale at considerably less effort over a shorter duration than traditional mark-recapture methods.

Development of a noninvasive method to sample cougars

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To set harvest quotas, evaluate management practices, and understand the dynamics of predator-prey systems, it is desirable to have reliable estimates of population size; however, assessing population demographics for large carnivores like cougars is a challenging task due to their elusive nature and large home-range sizes. Current methods to sample cougars usually involve a capture component, but obtaining reliable estimates can be difficult and cost prohibitive when using capture as the sole sampling method. Because cougars leave sign, and exhibit behaviors like territoriality and curiosity, a noninvasive-genetic-sampling (NGS) method can be a plausible alternative. Scat and hair contain DNA which can be genotyped to yield the individual identification necessary for population assessments and can be obtained without handling the animal. We tested NGS techniques to detect and obtain genetic samples from cougars. We evaluated attractants and hair-snaring techniques at lure sites in

two study areas in Colorado, one on the Front Range and one on the Uncompahgre Plateau, during February – April, 2012 and November – April, 2013. We tested auditory predator calls and scent lures in conjunction with hair-snaring techniques. We established 18 – 33 sites over eight 30-day sampling periods. At sites with auditory calls, we observed 149 site visits by ≥ 46 unique individuals. In addition, we obtained 59 hair samples. Due to the high detection rate and the variety of individuals observed, we suggest that auditory calls and hair snares are an effective way to assess the various population demographics that are needed to inform management decisions.

Urbanization drives differential prey use within an urban-wildland mountain lion population

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As mountain lion and human populations expand, mountain lions (*Puma concolor*) are increasingly found on the fringes of and, occasionally, within urban areas. How mountain lions utilize this habitat, and their role as a top predator in these novel communities is not well understood. We examined mountain lion foraging behavior (i.e. space use and diet) in a population along an urban-wildland gradient using stable isotope analysis and GPS location data. Stable isotope signature and urban space use were quantified for 27 individuals (6 male; 21 female). We estimated diet proportion using stable isotope mixing models, and found native ungulates to be the most important prey items, making up on average 60% of diet (95% CI: 34-82%). Our estimates showed a higher reliance on alternative prey items (i.e. domestic species, synanthropic wildlife and small mammals) than has been found in previous studies, which used kill-site analysis. Notably, individuals who foraged in areas of high human density showed significant enrichment in heavy isotopes of carbon and nitrogen ($P = 0.01$), indicating a greater reliance on alternative prey. This effect was independent of age-sex class, as well as physical condition. Therefore, management tactics focused on removal may target healthy individuals who are important for population viability, rather than unhealthy or young individuals. Importantly, mountain lions are still key predators of ungulate species, even in urban environments.

Telomere length as a proxy for biological age in Colorado black bears

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As long-lived opportunistic omnivores, American black bears (*Ursus americanus*) exhibit great plasticity in diet and habitat selection, and can become habituated to human resources. Such behavioral plasticity may affect an individual's rate of biological aging; understanding this process of aging and associated changes in fitness is essential to predicting population dynamics. Telomeres are repetitive and highly conserved DNA sequences that cap the ends of eukaryotic chromosomes, shorten with cellular replication, and are linked to long-term survival. Thus, we are exploring the use of telomere length as a molecular indicator of fitness and biological age. Using real-time PCR we are quantifying relative telomere length in over 300 hunter-harvested bears from across Colorado. We are examining individual factors that may affect biological aging such as diet, habitat, sex, size, and chronological age. Understanding how such factors may influence telomere length will allow us to explore the potential for determining biologically relevant age classes non-invasively. This study will have important implications for the utility of telomere length as a molecular marker in wildlife aging.

Migration patterns of adult female mule deer in response to natural gas development

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The Piceance Basin of northwest Colorado contains the largest migratory mule deer (*Odocoileus hemionus*) population in the state and one of largest natural gas reserves in the country. Understanding how energy development activities influence migratory behavior of mule deer will enhance mule deer management and inform future energy development planning. We compared spring migration routes of adult female mule deer fitted with GPS collars (n = 167) among four study areas that had varying degrees of natural-gas development from 2008 to 2010. Environmental factors influencing migration included snow depth, temperature and green-up on winter and summer range; increasing temperatures, snow melt and emerging vegetation dictated timing of winter range departure and summer range arrival. Duration of Piceance mule deer migration was relatively short averaging 4 to 8 days among the 4 areas examined (straight line distance between seasonal ranges averaged 33 - 45 km). Deer in poor condition migrated later than deer in good condition, but condition was similar among areas regardless of development status. Migrating deer did not avoid development activity, but used higher canopy cover, departed later, arrived earlier and migrated more quickly than deer from undeveloped areas. Large changes in timing of migration could have nutritional consequences negatively influencing reproduction/neonate survival, but the relatively minor shift of a couple/few days we observed should not result in long-term fitness consequences. Piceance Basin mule deer appear to avoid negative effects of energy development through behavioral shifts in timing and rate of migration. Comparisons from the Piceance Basin and south-central Wyoming will be presented to further address mule deer migration behavior in relation to energy development activities.

Forest cover change and mountain nyala protected areas management in Ethiopia

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The mountain nyala (*Tragelaphus buxtoni*) is an endemic spiral horned antelope found only in the Ethiopian highlands east of the Rift Valley. Currently, the mountain nyala is listed by the IUCN as *endangered*, a status it has held since the early 1970s despite uncertainty about the species' total population. This economically and culturally valued species is found primarily in the Bale Mountain region which is one of the few remaining forested landscapes in Ethiopia where people and wildlife co-exist. This area is undergoing rapid land conversion in the face of accelerated human population growth. Fortunately, multiple protected areas with different management strategies have been established, in part, as an effort to conserve mountain nyala habitat. Our objectives were to map and quantify forest for three different protected areas to evaluate their effectiveness at protecting mountain nyala critical habitat. The management of the protected areas included a state sponsored forest enterprise, a national park, and a Controlled Hunting Area operated by a private safari company. We used Landsat TM imagery from 1987 and 2010, field verification data, and a suite of geospatial data in an integrative spatial modeling and classification approach to quantify forest cover change. We compare our results to recent demographic and population estimates specific to these protected areas. We conclude that although there is uncertainty surrounding the hunting of an endangered species, our results demonstrate Controlled Hunting Areas in Ethiopia are equally or more effective at protecting critical mountain nyala habitat than other protected areas.

Survival of the Rocky Mountain sandhill crane

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The sandhill crane (*Grus canadensis*) is one of the longest lived of game bird species. Species with its life history tend to have relatively constant adult survival rates over time, mitigating environmental stresses by reducing reproductive effort. Given its low natural mortality rate, crane populations are not robust to large harvest rates, even if compensatory mortality is applicable. We evaluated survival of Rocky Mountain Population Sandhill Cranes from 1969-92, based on a mark-resight/recovery program. This includes time periods before and after initiation of sport harvest. Most cranes were banded as juveniles, on the breeding grounds, and the resighting period was centered in the winter. Therefore we estimated survival of the first six months, and then annual survival thereafter. We modeled crane survival as a function of age, body condition, and pre- or post-sport harvest. We also modeled relative vulnerability of cranes to hunting vs. non-hunting sources of mortality. Survival estimates were adjusted for loss of field-readable marks over time. Juvenile survival for the first six months was dependent on body condition, and on whether hunting occurred. Hunting also reduced survival from age 0.5 to 1.5 years, but had no effect on survival for age >1.5 years. Up to age 4.5, cranes were more vulnerable to non-hunting sources of mortality, relative to cranes age >4.5. The apparent lack of hunting impact on adult crane survival is based on data only up to 1992. A new banding program for cranes could test whether harvest is more additive with current harvest levels.

Wildlife camera trapping: variables influencing encounter rates in occupancy and relative abundance indices

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Despite the increased usage of passive infrared camera traps in combination with occupancy and relative abundance indices for monitoring/researching wildlife; resulting inferences from these metrics may be misinterpreted and/or biased if potentially confounding variables are unaccounted for. I conducted simulations using an agent based model to demonstrate how encounter rates, which are the basis for relative abundance indices and the detection probability parameter in occupancy models, can be influenced by not only by underlying abundance, but home range size, movement rate, trigger delay period, and the dimensions of the camera's field of view. However, the field of view dimensions are often non-discrete, as the probability of detection may change as a function of: distance to the passive infrared sensor, environmental conditions, and attributes of individual animals.

A recent epizootic of skunk rabies and associated spillover in Northern Colorado

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Rabies is a fatal viral zoonosis that is transmitted by bite contact with an infected animal. In the US, human deaths are rare, but each year over 5000 rabid animals are reported and over 90% of cases are from wildlife. Carnivores and bats are the primary sylvatic reservoirs in the US, and several variants circulate independently among these two taxonomic orders. Rabies prevention efforts led by USDA Wildlife Services using live recombinant vaccine baiting began in 1995 and primarily target raccoons and canids, but the territory of the south-central skunk rabies virus variant has expanded in recent years, leading to incursions into areas previously free of carnivore rabies. Colorado has been one such area where bats were the only sylvatic reservoir of rabies prior to 2007. By 2012, the number of rabid skunks exceeded rabid bats in Colorado. Larimer County and Weld County, in Northern Colorado, both witnessed skunk rabies epizootics starting in 2012 that have continued through 2013. Despite spillover events into raccoons, foxes, domestic animals and livestock during 2012 and 2013, only skunks appear to support terrestrial rabies virus circulation in Northern Colorado. We describe the spatiotemporal pattern of the local epizootic and predict likely areas of spread along the Front Range of Northern Colorado. Virus isolation success from salivary glands of rabid animals can inform the likelihood for secondary transmission from skunks or other spillover hosts, and will guide intervention strategies targeting wildlife.

Evaluation of a novel bait for oral rabies vaccination of wildlife reservoirs: consumption and bait fate

Shylo Johnson, Nikki Crider, Tara Rigg, Christine Ellis, and Kurt VerCauteren

Rabies is a lethal zoonosis that rabies managers are attempting to control and eradicate from wildlife reservoirs of the disease. Oral rabies vaccination (ORV), the distribution of baits containing rabies vaccine throughout the landscape, is a primary tool used to work toward this goal and the Wildlife Services/National Rabies Management Program distributes over 6.8 million ORV baits in the US each year. Both bait distribution and bait matrix composition influence vaccination success rates during ORV. In an effort to improve vaccination success rates, we are testing a novel bait matrix for consumption, flavor preference, and fate in pen and field settings. Using captive raccoons (*Procyon lotor*), we conducted a cross-over single choice trial using fish- and sweet-flavored baits followed by two-choice trials comparing both flavors. The raccoons consumed 81.5% of fish- and sweet-flavored baits within four hours of exposure to the baits, with consumption reaching 100% at 24 hours. They preferred fish (W=0, $p<0.05$) in the two-choice trials. We are currently repeating the same trials with captive striped skunks (*Mephitis mephitis).* To assess bait acceptance in the field, we set bait stations consisting of a motion-activated camera monitoring a single bait in multiple locations in October 2013 within rural and urban Larimer County, Colorado. Each location was monitored up to five days. Analysis of the photographic images is underway and we are documenting that wild raccoons and skunks consumed baits. Results of these pen and field efforts are demonstrating that this bait matrix has great potential for use in operational ORV. Next steps will include determining if vaccine-laden baits of this novel matrix outperform the ORV bait-types that are currently being employed operationally.

Technical Session Abstracts
Session 2:

Wildlife movement guilds: a classification system for road ecologists

Julia Kintsch, ECO-resolutions LLC
Patty Cramer, Utah State University
Sandra Jacobson, USDA Forest Service

Restoring landscape connectivity including a permeable road network that supports wildlife migration, dispersal and other movements is based in the science of animal behavior and physiology, specifically, how animals respond when they encounter roads and potential crossing structures. The Wildlife Movement Guilds comprehensively address the biological and environmental factors that influence an animal's use of crossing structures and other roadway mitigation, and allow any North American species of terrestrial wildlife to be categorized into one of eight classes. Previous studies in road ecology have proffered classifications based on taxonomic classifications (e.g., Grillo et al 2010), body size (Clevenger and Kociolek 2006), how species respond to habitat fragmentation (Cavallaro et al 2005), or a combined approach based on body size and species area requirements (Clevenger and Huijser 2009). We developed the Wildlife Movement Guilds as a refinement of these previous road ecology classifications. The Guilds categorize wildlife according to multiple behavior-influencing factors including, body size; how a species moves; how a species responds to roadway traffic or potential threats such as predators; and how a species responds to crossing structure characteristics, such as vegetation cover, visibility and ambient cover, that may affect a species willingness to use different structures to move under or over roads. Predator avoidance is a key factor for most wildlife. As different species have different detection and avoidance strategies, effective mitigation along roads must address the strategies of the target wildlife at a given location. The Wildlife Movement Guilds allow biologists to evaluate the physical and environmental conditions and potential constraints to movement of wildlife from the perspective of groups of species, and develop mitigation strategies that carefully consider the behavior and preferences of the target species. By offering a new way of thinking about wildlife the Guilds help to inform design characteristics for new structures or the for retrofitting existing infrastructure, with many practical applications for biologists, transportation planners and other infrastructure development.

Using standardized survey protocol frameworks to facilitate cooperative landscape-scale wildlife monitoring: the RMBO/FWS landbird survey protocol framework

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The U.S. Fish & Wildlife Service (FWS), Inventory and Monitoring Initiative (I&M) has begun the process of developing, adapting and approving natural resource survey protocols for use by wildlife refuges, so that monitoring efforts by refuges are scientifically rigorous and compatible and the data collected can be pooled at multiple scales. We are also promoting collaboration with partners so that data can be analyzed across boundaries to monitor wildlife population trends and answer questions at larger scales. We are developing and adopting standardized protocols in several ways. In this case, the FWS I&M contracted with Rocky Mountain Bird Observatory to format their existing landbird survey protocol, currently used across the Intermountain West and Great Plains Regions, to follow new FWS standards. This protocol will be used by national wildlife refuges in the region to conduct landbird surveys by a standardized methodology, to enable pooling of survey data and analysis of landbird populations at landscape-scales.

Impacts of elk and vegetation management on songbirds of Rocky Mountain National Park

Apryle D. Craig and Liba Pejchar Goldstein, Colorado State University

Riparian willow (***Salix*** spp.) communities in Rocky Mountain National Park (RMNP) are declining in large part because of elk herbivory. In 2008, RMNP began installing elk exclosure fences in the park's heavily-browsed valleys with the goal of restoring vegetation and the wildlife that depend on riparian ecosystems. Our objective was to evaluate the effect of elk exclosures and willow condition (percent cover and height) on songbird communities. We surveyed for birds and small mammals inside and outside exclosures and along a gradient of willow condition during two summer field seasons. Bird response was mixed; the relationship between bird occupancy and abundance and willow structure varied by species and guild, with some species and groups showing positive correlations with willow height, canopy density, or both and others showing no effect. Our findings provide park managers critical information on plant and bird communities in the elk exclosures five years after establishment, and insight into the conditions needed to support songbird communities in the park's riparian ecosystems.

Evaluation of the Raven small Unmanned Aircraft System (sUAS) to detect and monitor greater sage-grouse leks within the Middle Park population

Chris Holmquist-Johnson , Research Hydrologist, USGS Fort Collins Science Center
Leanne Hanson, Biologist, USGS Fort Collins Science Center
Michelle Cowardin, Colorado Parks and Wildlife

High male counts on leks are used to assess population trends for greater sage-grouse (*Centrocercus urophasianus*) in Northwestern Colorado. Lek surveys are conducted in early spring either through aerial or ground counts. Access to the sites can be difficult due to terrain ruggedness, ground conditions, and remoteness. In April 2013, we tested the potential use of the Raven RQ-11A small Unmanned Aircraft System (sUAS) to detect greater sage-grouse on two known leks in the Middle Park population. Known sites were flown to determine the reaction of the grouse to the aircraft, which imagery sensors are best suited for detecting the birds (thermal infrared or visible wavelength), and to establish the optimum flight altitude. In addition, we wanted to determine if the technology had potential for future use of locating new leks and obtaining accurate population counts on known lek sites. This study proved that the Raven sUAS provides a non-intrusive and safe method to detect greater sage-grouse on known lek sites. Potential 2014 flights will include testing upgraded sensors and determining a flight methodology to obtain an accurate male count on the leks. Future studies would involve using the Raven sUAS to search for new lek sites.

Gunnison sage-grouse (*Centrocercus minimus*) vocalization reduction in response to anthropogenic noise sources within the Gunnison Basin, Colorado

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A broad range of research has documented that noise disturbances can contribute to changes in behavior, breeding success, density, and community structure among a variety of wildlife species. The Gunnison Sage-grouse Rangewide Conservation Plan (RCP) recommends that continuous noise sources in the proximity of sage-grouse leks be limited to 10 dBA above ambient, however ambient levels have not been determined. Using a real time frequency analyzer and an acoustic recorder we measured amplitude and frequency, and quantified the source of anthropogenic noise on twelve separate Gunnison Sage-grouse leks during their displaying season in the spring of 2012 and 2013. We discovered that proximity to anthropogenic noise sources was related to significant differences in amplitude. We discuss the best estimates for undisturbed ambient noise levels and demonstrate that current anthropogenic noise levels exceed RCP recommendations. Utilizing all leks examined, we also found a significant

reduction in grouse vocalizations during and after noise events caused by passing aircraft and nearby vehicle traffic (highways from 0.3-4.3 miles from leks). We developed a mixed effects model which predicted the anticipated reduction of vocalizations for any given lek, on any given day, for any anthropogenic noise source. These results provide a baseline for studies of anthropogenic noise levels and suggest that short-term noise events disrupt sage-grouse lekking behaviors, though such noise sources are not addressed by current RCP recommendations limiting continuous noise sources.

Engaging youth in wildlife-related recreation through science education

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Societal changes are influencing how people interact with the natural environment. Learning about nature among children increasingly occurs in indirect ways as opposed to direct day-to-day experiences (Kahn & Kellert, 2002). Given the well-established relationship between time spent outdoors as a child and future commitment to natural resource stewardship (Louv, 2008), a decrease in direct interaction with nature raises concerns about whether future generations will be interested in management and conservation of natural resources, including wildlife. This growing disconnect is of concern to state fish and wildlife agencies that rely upon park visitation and recreation participation to fund conservation initiatives (Pergams & Zeradic, 2006, 2007). A successful response on the part of these agencies will depend in part on the reach and effectiveness of youth conservation education. This calls for rigorous evaluation of programs to ensure objectives are met (Heimlich, 2010). Colorado Parks and Wildlife and Colorado State University partnered with Bookcliff Middle School to embark on a four-year evaluation of the Outdoor Wilderness Lab (OWL), a place-based weeklong outdoor education program for sixth grade students, in order to determine whether the program met its objectives and identify areas for improvement. During Year 1, we assessed the extent to which participating in the OWL contributed to knowledge about, attitudes toward, and intentions to participate in outdoor recreation in Colorado, with particular attention given to hunting and fishing. Results from Year 1 will be shared in addition to lessons learned as we move forward with the evaluation plan for Year 2.

Human dimensions of coyote management in the Denver Metro Area: a spatially explicit approach to understanding public and manager perspectives

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Tara L. Teel, *Associate Professor, Human Dimensions of Natural Resources, Colorado State University & President, Social Science Working Group, Society for Conservation Biology*
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Interaction between urban/suburban residents and coyotes is becoming increasingly common in North America. The coupling of coyote adaptability with the expansion of metropolitan areas has led to increased reports of coyote observations (sightings, encounters) and conflict incidents (pet injury/loss, attacks on humans) in urban/suburban settings. This wildlife management challenge illustrates the need for an integrated research focus that considers a wide range of social, ecological, and institutional factors. A multidisciplinary study is underway in Colorado's Denver Metropolitan Area (DMA) to better understand these factors. Spatial and temporal patterns of human-coyote conflict across 22 managerial entities in the DMA were recently described by Poessel et al. (2013). This presentation discusses how these patterns of reported conflict were used to guide the implementation of a spatially-explicit human dimensions study in the DMA. Mail-back and online questionnaires (n = 4,179) gathered data on residents' experiences with coyotes and attitudes toward coyote-related issues and management strategies. A separate survey of management professionals (n = 31) offers details about how different entities are

responding to coyote incidents throughout the DMA. Findings of these investigations can be used to inform targeted mitigation efforts by identifying coyote conflict hotspots that include consideration of social factors. Additionally, results provide a baseline to facilitate an evaluation of coyote-related public outreach campaigns. Future initiatives focused on the creation of an integrated spatial database that links social and managerial data with results from ongoing research on the ecology and behavior of urban coyotes in the DMA will also be discussed.

Applying social science to inform conservation solutions regarding owned outdoor cats in urbanizing landscapes

Ashley Gramza, Tara Teel, Sue VandeWoude, and Kevin Crooks**,** Colorado State University

Free-ranging domestic cats (*Felis catus)* incur and impose risks on ecosystems and represent a complex issue of critical importance to wildlife conservation and domestic cat and human health. There is an inherent social dimension to the issue of owned free-ranging cats, as humans are their caregivers and can contribute to the cause as well as the solution of this issue. To address this social component, we examined public risk perceptions and attitudes towards owned free-ranging cats along a gradient of urbanization via a survey of residents in two study areas in Colorado. Residents did not view all types of risks uniformly; they viewed the risks of cat predation on wildlife and carnivore predation on cats as more likely than the risks of disease transmission to and from wildlife. Additionally, risk perceptions were related to such factors as attitudes and general beliefs about cats, prior experiences with cats and their interactions with wildlife, and cat owner behavior. These findings provide support for the notion that changes in risk perceptions can result in behavior change, and they offer insight for development of communication campaigns aimed at promoting risk aversive behaviors and cat management strategies that are both acceptable to the public and have direct conservation implications. Our study can also be used as a model for further research focused on integrating social and biological data to inform conservation of wildlife and wildlife habitats.

Using species conservation banks to offset the need for species listings and aiding recovery under the Endangered Species Act: sage grouse and Colorado plants examples

Al Pfister, Western Wildscapes, LLC

The listing of a species (or subspecies) under the Endangered Species Act of 1973 is based on whether or not a species qualifies under one of the five listing factors. The USFWS determines if a species is included on the list of endangered/threatened species when at least one of the five listing factors is applicable to a particular species/subspecies.

The five listing factors are:

A. Present or future destruction or degradation of the species/subspecies habitat
B. Overutilization for scientific or recreational purposes
C. Disease or predation
D. Inadequacy of existing regulations
E. Other stochastic or natural events

Establishment of a conservation bank can reduce or potentially eliminate the applicability of at least two of the listing factors and potentially all listing factors – depending on the species current status and the threats to its future conservation. The applicability of banks providing long-term conservation benefits such that they preclude the need to list species will be discussed relative to the greater sage-grouse and two listed Colorado plants, especially Factors A and D. Challenges to establishing banks for unlisted species and listed plants will also be covered. The potential for banks to assist in the recovery and delisting of species will be discussed with the same species (i.e., addressing the listing factors, but show how the threats have been minimized or eliminated). The proposed Gunnison sage-grouse, and candidate greater sage-grouse, Dudley bluff bladderpod, and twinpod will be discussed as relevant examples

Collaborative wildlife management contracting in a state wildlife agency: pointing at an elephant in the room?

Robert K. Towry, RKT LLC

Use of collaborative management approaches, defined here as the sharing of responsibilities and resources with partners to achieve management goals, is anecdotally reported as increasing within state wildlife agencies (SWAs). Collaborative approaches are also encouraged as part of the SWA "transformation" literature and activities. Examining 12 years of the Colorado Division of Wildlife's (CDOW) accounting records confirms increased expenditures through contract types categorized as supporting collaborative management. The record also captures the influences of complex interactions of increased spending, nontraditional funding, administrative policy changes, and partner preferences on collaborative contract use. The large scale picture is one of declining collaborative contract numbers, increasing contract values and increased use of grants. CDOW employee interviews portray collaborative contract development and implementation as an ad hoc process where development and administration rests largely on employees who champion projects or are assigned by management. Interviews noted frustration with procurement and administrative processes and pessimism about increased support for contract management and administration. Limited evidence of strategic planning and capacity development related to collaborative management is reported in the interviews. SWAs were also characterized as unlikely to relinquish leadership roles in wildlife matters within the state. These results suggest SWAs take steps to strategize on expectations about collaborative wildlife management and act to align agency capacities as appropriate. The wildlife profession faces similar choices in defining the wildlife professional's role in collaborative wildlife management settings and how to shape professional development to match the anticipated role.

Poster Abstracts:

Using constraints on animal movement to model telemetry measurement error

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Telemetry data are pervasive in wildlife studies and are often treated as measurements of true location; however, even highly advanced telemetry devices measure location with uncertainty. Measurement error, or the difference between the recorded telemetry location and the true location, can interact with covariate heterogeneity and the temporal resolution of location estimates to bias biological inferences. Incorporating telemetry error into models of animal movement and resource selection is therefore an important consideration. Unfortunately, observed error patterns can differ in unpredictable ways between different species, environments, and geographic locations. Consequently, no single description of telemetry measurement error may be universally applicable. We propose an approach that uses constraints on animal movement to simultaneously estimate and account for telemetry error. Constraints on animal movement come in varying forms and degrees of permeability (e.g., fences, roads, powerlines, railroads, etc.). We parameterize a model for observed telemetry data conditional on true locations that reflects prior knowledge about constraints in the animal movement process. When specified in a Bayesian framework, the model is simple, concise, and flexible. As a case study, we apply this model to Argos telemetry data from harbor seals (*Phoca vitulina*) in Alaska, a species that is constrained to move within the marine environment and onto adjacent coastlines.

Identifying dispersal in *Lynx canadensis* using a coupled telemetry model

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In light of increased habitat fragmentation and climate change, the ability of individuals to move between suitable habitats will become a determining factor in their survival as a species. Long-distance dispersal, though rarely differentiated from short-distance, is the main determinant of the rate of population spread, making it a relevant metric for invasive species, range shifts, reintroduction programs, metapopulation dynamics, and connectivity. For terrestrial mammals, long-distance dispersal events may be evident using data arising from global positioning collars that transmit locations on a pre-determined schedule or by very-high frequency collars that are monitored by hand-held receivers. However, different data collection methods are inherently associated with different types of measurement error. Furthermore, telemetry data arising from different devices may be irregular and/or misaligned temporally. To identify when dispersal occurs, we developed a hierarchical model that reconciles our two sources of telemetry data that have differing strengths and weaknesses. We evaluated this model using simulations and applied it to individual lynx that were reintroduced by Colorado Parks and Wildlife to Colorado between 1999 and 2006 and monitored from 1999 to 2011. Our hierarchical model properly accounts for variation in telemetry error while providing rigorous estimation of the uncertainty associated with our understanding of long distance dispersal and corridor use.

Evaluation of the Raven small Unmanned Aircraft System (sUAS) for wildlife assessment: population estimates of sandhill cranes (*Grus canadensis*) and detecting and monitoring greater sage-grouse (*Centrocercus urophasianus*) leks in Colorado.

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Wildlife population counts are traditionally conducted either from ground or fixed-wing aircraft observations; however both of these methods have limitations (accuracy, cost, safety and timeliness). Small unmanned aircraft systems (sUAS), and their cameras and sensors, have recently been tested for their suitability to provide accurate population estimates of sandhill cranes (Grus canadensis) and detect greater sage grouse (Centrocercus urophasianus) in Colorado. The first FAA-approved sUAS flights in the national airspace were conducted in March 2011 using the Raven RQ-11A sUAS at Monte Vista National Wildlife Refuge. These flights determined the suitability of the sUAS to count sandhill cranes, by comparing ground counts to counts from sUAS imagery. In 2012, the first FAA-approved sUAS night flights were conducted at Monte Vista, to obtain a population estimate of the number of roosting cranes at three roosts on the Refuge. In April 2013, the sUAS was flown over greater sage-grouse leks (breeding sites) in Middle Park to determine if the system could detect greater sage-grouse and what (if any) reaction the sage-grouse might have to the sUAS. In addition, we wanted to determine if the technology had potential for future use of locating new leks and obtaining accurate population counts on known lek sites. These studies proved that the Raven sUAS provides a non-intrusive, safe and accurate way to estimate sandhill crane population abundance on roost sites, and detect greater sage grouse on lek sites. This new technology is available to natural resource managers to track wildlife population numbers, health, and trends.

Evaluating habitat use of an Alaskan Dall sheep (*Ovis dalli dalli*) population via camera traps

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The study of Dall sheep (*Ovis dalli dalli*) is often constrained by the variable terrain, extreme climate, and at times cryptic nature of the species. Studies of these mountain ungulates often rely upon aerial or road-based surveys to assess population size and regional habitat use. Infrequently, camera traps have been employed to estimate population size and presence of mountain ungulates, but little use has been directed towards Dall sheep. Camera traps are an increasingly utilized tool for the management and study of numerous taxa of wildlife. My study will utilize camera traps to determine the occupancy of Dall sheep within the U.S. Army's Donnelly and Black Rapids Training Areas of Fort Wainwright, Alaska. An assessment of the local sheep population has been deemed necessary by the U.S. Army due to the expansion of military exercises. A system of camera traps, installed via a spatially balanced design will assess the seasonality and habitat use of sheep in the military training area beginning August 2013 through August 2016. These data, in concert with aerial and scat surveys surrounding camera locations, will allow for occupancy modeling using multiple detection methods. Results will determine recommendations to the U.S. Army as to the most appropriate time to conduct military exercises in the study area as it pertains to sheep presence. In addition, novel techniques of camera trap installation and use in mountainous tundra may inform other researchers conducting wildlife investigations in similar environments.

Effects of conservation development design and stewardship on birds and mammals in Northern Colorado

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Rapid expansion of residential development is a leading threat to biodiversity. Conservation development (CD) is designed to decrease negative environmental impacts by clustering houses on a portion of a property while preserving the remaining land as protected open space. Our study aims to identify design and stewardship factors that influence the occurrence and community composition of birds and mammals in CD subdivisions in Northern Colorado. We are conducting point counts, acoustic monitoring, and deploying camera traps in 15 CDs and 4 undeveloped reference sites in Boulder and Larimer counties, and measuring design and stewardship factors such as open space area, housing density and configuration, permeability, surrounding land use, recreation, resource subsidies, and vegetation. Using an occupancy modeling framework, we will evaluate the relative effects of these factors on wildlife occurrence. Preliminary results indicate that CDs with larger protected open spaces support greater species richness; sites with protected area greater than 150 ha had 1.40 times the number of bird species and 1.45 times the number of mammal species than sites with protected area less than 30 ha. Human-sensitive species such as horned larks, vesper sparrows, and spotted towhees were detected less often in protected space in close proximity to greater housing density. The presence of free-ranging dogs decreased coyote occurrence, and also decreased avian species richness by 21%. The results of this study will provide land use planners, developers, and homeowners with practical recommendations for the successful design, construction, and stewardship of CDs that conserve native birds and mammals.

Emerging wildlife diseases: enhancing research and management of vector-borne pathogens with molecular phylogenetics

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Biting midges in the genus *Culicoides* (Diptera; Ceratpogonidae) are vectors of a diverse array of wildlife pathogens including viruses, protozoa, and filarial worms. Many of these pathogens are ubiquitous in North American wildlife (e.g., avian blood parasites), while others (e.g., bluetongue virus (BTV) and epizootic hemorrhagic disease virus (EHDV)) are enzootic to certain regions. BTV and EHDV are listed by the World Organization for Animal Health as global threats to domestic and wild ungulates and cause major outbreaks outside enzootic areas. Despite their ubiquity and the severity of disease arthropod-borne wildlife pathogens can cause, very little is known about the basic biology of the majority of vector species. Disease risk assessments, prediction of epizootics, surveillance, and response to outbreaks of *Culicoides*-transmitted pathogens suffer due to convoluted vector taxonomy, unknown evolutionary relationships, and limited ecological data. *Culicoides* midges are exceptionally challenging to identify because they are small, fragile, have obscure morphological characters, and the expertise in *Culicoides* taxonomy is rapidly waning. The goal of this ongoing study is to alleviate the paucity of scientific data about North American *Culicoides*. The two main tasks are to investigate the phylogenetic relationships of these vectors using the DNA barcode region and place these North American data within the context of a global genus-level phylogeny. Here we provide preliminary results from this research examining current taxonomic hypotheses for *Culicoides*. This work will greatly benefit wildlife disease management by facilitating rapid and accurate vector species identification leading to improved geographic disease risk assessments and response.

The State Highway 9 Safety Improvement Project: collaborative stakeholder involvement in the design, funding and monitoring of wildlife crossings to mitigate wildlife-vehicle collisions in North Central Colorado

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John Kossler, Range Ecologist, Blue Valley Ranch, Kremmling, CO

Safe highways are critical for both local communities and local wildlife populations. Colorado State Highway 9 north of I-70 is a major north-south transportation corridor in regional Northwest Colorado. This section of road bisects the Middle Park mule deer (*Odocoileus hemionus*) herd winter range. The 10.6-mile stretch between Green Mountain Reservoir and the town of Kremmling has been witness to 590 vehicle accidents in the 20 years, including 16 fatalities, 36% of which were officially documented as wildlife related. In the last 8 years local wildlife managers documented 455 wildlife-vehicle collisions, mostly mule deer, in this corridor. These statistics fueled an unprecedented cooperative grassroots campaign that secured $36.2 million of funding though the CDOT's RAMP program. In addition to the highway safety improvements this project includes wildlife fencing, escape ramps, five underpass crossings, and the first two wildlife overpass crossings ever constructed in Colorado. CPW and CDOT hope to work together to monitor the project both pre and post construction using effectiveness monitoring as a research strategy for studying specially designed wildlife crossings to determine success in mitigating wildlife-vehicle collisions while maintaining habitat connectivity. Monitoring methods will include carcass counts and motion-triggered cameras. Efforts are planned to begin fall 2014 and continue for at least 5 years post-construction in order to contribute towards a cost-benefit analysis.

Research-in-progress: assessing bird-mediated ecosystem services and disservices in Colorado orchards.

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Birds can benefit agriculture through services such as pollination and pest control, but they also damage crops through seed and fruit depredation. To achieve ecological sustainability, agriculture must be economically viable while also conserving natural biodiversity. The objective of our study is to investigate the ecological and economic costs and benefits of birds in Colorado's orchards by evaluating pest control and fruit depredation. Specifically, we will 1) determine the most important bird species causing damage and providing pest control services, 2) measure the rate and magnitude of these services and disservices throughout the growing season, 3) identify avian sensory cues associated with foraging, and 4) quantify costs and benefits of maintaining birds in orchards in biophysical and economic terms. Methods will include point transects to measure bird abundance and occupancy, mist-netting and foraging observations to determine bird consumption of insects and fruit, and exclosures to measure insect damage and fruit depredation in the presence and absence of birds. Captive feeding trials and analytical chemistry will be used to investigate sensory cues for preferred foods. These biophysical data, along with existing economic data, will be used to evaluate the role of birds in orchards under various management scenarios (e.g. excluding birds, enhancing habitat for birds, and/or using pesticides). Our results will also contribute to the field of sensory ecology by providing new information on the relationship between foraging and sensory cues in orchards. Overall, our findings will provide novel insights and support practical solutions for optimizing agricultural productivity and conservation benefits.

Colorado State University wildlife camera educational outreach with Boltz Middle School

Rebecca Much[1], Alex Arvin[1], Genevieve Fuller[1], Kerry Gold[1], Emily Grabowsky[1], Meredith Kittelson[1], Samuel Peterson[1], Toryn Schafer[1], Jordan Baumgartner[1], and the Boltz Middle School 6th Grade Science Class, Kevin Crooks[1]

[1]Colorado State University

As part of an ongoing K-12 education and outreach effort, the undergraduate chapter of The Wildlife Society at Colorado State University (CSU), along with Dr. Kevin Crooks in the CSU Department of Fish, Wildlife, and Conservation Biology, assisted Jordan Baumgartner's 6th Grade Boltz Middle School science classes with wildlife camera surveys in Pineridge Natural Area (PNA), Fort Collins, CO. In Fall 2013, six remote cameras were positioned throughout PNA and used as a tool to teach Boltz students about local wildlife, food webs, and how to develop research questions and graph data. Cameras in PNA were placed in a variety of habitats, including riparian forest, shrubland, a prairie dog colony in short-grass prairie, and off-trail in ponderosa pine forest. In the classroom setting, CSU students visited Boltz at the beginning of the school year to present an overview of remote camera methodology as well as wildlife species present at PNA. Boltz students used the initial information from the CSU presentation to develop food webs and create research questions. Next, Boltz students visited PNA to learn firsthand about the remote cameras, data collection methods, and habitat types. After the field visit, CSU students returned to Boltz to present data on the number of wildlife species recorded by each camera along with a selection of the best wildlife photos and videos captured by the cameras. Boltz students used these data to graph their findings. The collaborative effort between CSU, Poudre School District, and Fort Collins Natural Areas provided an excellent opportunity to teach lessons in ecology using a local natural area. This project demonstrated the differences and diversity in local wildlife species and their habitats, allowing Boltz students to draw real-life connections to their ecology curriculum.

Using protocols to enhance scientific credibility of inventory and monitoring at National Wildlife Refuges

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One of the goals of the new Inventory and Monitoring (I&M) initiative of the US Fish and Wildlife Service is to enhance the scientific credibility of natural resource surveys that influence management decisions at stations of the National Wildlife Refuge System. The first step to meeting this challenge was to establish in policy that inventory and monitoring surveys on refuges, be guided by written protocols. To ensure this requirement could be achieved, we developed a handbook that explained the standard for the content, and the process for developing survey protocols and getting them approved. This poster describes eight fundamental elements in a protocol that will guide a survey from stating objectives and establishing the sampling design through data analysis, reporting and archiving. The poster also explains how existing protocols can be used as frameworks to develop site-specific protocols for surveys conducted at stations of the National Wildlife Refuge System, and how newly developed protocols are reviewed and approved. Rigorous attention and implementation of survey protocols will enhance credibility of survey results by promoting use of accepted methodologies, transparency, repeatability, and other principles embodied in the scientific method.

Habitat factors limiting Wyoming toad (*Anaxyrus baxteri*) survival and growth at a reintroduction site in the Laramie Basin of Wyoming

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Understanding the habitat factors limiting the growth and survival of early life stages of the Wyoming toad (*Anaxyrus baxteri*) is essential for successful recovery of this critically endangered species. During 2013 we used mesh field enclosures placed at Mortenson Lake National Wildlife Refuge to determine (1) if water temperature and vegetative cover limit tadpole survival and growth; and (2) if vegetation height limits metamorph survival and growth. We found that tadpole growth and survival rates were not significantly different among the four treatment types that varied water temperature and vegetative cover; however, accumulated temperature (i.e. degree days) was highly influential on the time it took for tadpoles to metamorphose. Moreover, light penetration was influential on size at metamorphosis, but only when co-explained by treatment type, degree days, or water depth. Metamorph growth and survival rates were also not significantly different among the four vegetation treatments (heights) but mid-vegetation heights had the lowest occurences of small metamorphs (snout-urostyle length <16mm) suggesting mid-vegetation heights may be least limiting on metamorph size. Our results indicate that while accumulated temperature drives developmental rate, light penetration associated with shallower water depths is a key driver of size at metamorphosis. In addition, mid-vegetation heights appear most ideal for obtaining larger sized metamorphs prior to hibernation, particularly with the use of soft-release enclosures that can increase natural survival rates. Managing for vegetated, shallow water habitat for tadpoles and mid-vegetation heights (~10-30cm) for metamorphs may increase survival of early life stages, contributing to the Wyoming toad's recovery.

Measuring oxygen consumption in captive South American sea lions (*Otaria flavescens*)

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To maintain an animals health while in captivity requires knowledge of their metabolic demands. One method of determining an animals metabolism is by measuring the rate of oxygen consumption. This study will measure the rate of oxygen consumption of a captive South American sea lion (*Otaria flavescens*) while at rest. The study was conducted in conjunction with Coral World Ocean Park in St. Thomas, USVI. Rate of oxygen consumption is an important measurement of metabolism which enables the animal care staff to estimate the diet or energy requirements of the animals. It is also used in the calculation of the aerobic dive limit (ADL) of the animal. The ADL is the threshold at which a diving animal can hold its breath without building up lactic acid in its muscles. Here we present a safe and effective method to obtain these measurements in captive pinnipeds.