Biological Sciences – Terrestrial

Plenary Session Abstracts in Order of Presentation

Wildlife Management With a Capitalistic or a Socialistic Flavor: A Comparison of Montana with Norway

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Montana and Norway passed laws in 1897 and 1899, respectively, which set the stage for today's wildlife management. These laws were part of an effort to conserve dwindling populations of large ungulates. The Montana Legislature decided that the responsibility of wildlife management would rest primarily with the State, whereas the Norwegian Parliament decided that it would rest with the landowner. These efforts to conserve native large ungulates were successful in both Montana and Norway, but the choice of philosophically different ways to accomplish it led to very different management systems. I argue that Montana chose a socialistic system, in the sense that everyone has the same right to hunt and fish. Norway chose a capitalistic system with the landowners owning the hunting and fishing rights. I will argue that this has had major implications for the differences between these two entities in political support for wildlife, hunting methods and ethics, and wildlife conservation in general.

Five Managers, Five Continents, Perspectives Shared

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Wildlife management and conservation are dynamic, solving problems on landscapes where people live, work and recreate. Manager to manager exchanges are as relevant to advancing conservation knowledge as professional publications, but have yet to reach the same institutional/cultural application within our profession. Many in the world focus on total protection and protected areas as the basis for conservation, i.e. the Yellowstone model. Today, a new focus is emerging on conservation through management, recognizing that most of the world's land base occurs outside of protected areas. This presentation will focus on shared experiences between wildlife managers on five continents. It will begin with introduced species (red deer) management and plant/rangeland ecology in the Patagonia region of Argentina; then disease concerns, wildlife tolerances, livestock husbandry in the Serengeti, Mara and Mara Conservancy areas of Tanzania and Kenya. It will bring perspectives to hunting season management of red deer and relationships to Amur tiger conservation in the Russian Far East. Finally, it will land in northern Europe to discuss livestock (reindeer) predation experienced by the Sámi people of Norway and Sweden, and their reindeer loss reimbursement approach. The experiences and perspectives gained and shared by Montana wildlife managers and biologists will be discussed, as they have changed our season setting applications and are refining predator/ prey/livestock management in Montana. In today's time, manager to manager exchanges may become the most relevant approach to advancing new management and conservation thoughts, philosophies, research initiatives, and policies.

Beyond Borders: World Wildlife Fund's Transboundary Wildlife Conservation Projects in the Northern Great Plains

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The World Wildlife Fund's (WWF) Northern Great Plains Program (NGP) spans five states and two provinces across 279,000 mi^2 of mixed-grass prairie. Since its inception as an ecoregional program in 2003, the WWF NGP has been engaged in numerous multi-jurisdictional and cross-border initiatives designed to foster communication and coordinate actions to achieve biodiversity conservation in the shared landscapes. From black-footed ferret restoration, long-billed curlew migration, and cougar research to climate change adaptation and conservation economics, we collaborate, financially contribute to, and lead over 50 projects with as many domestic and international partners. One set of partnerships is centered in northern Montana, southwest Saskatchewan, and southeast Alberta focused on conserving crucial habitats and connectivity for pronghorn. This project area is also home to other partnerships WWF participates in, such as the Prairie Pothole Joint Venture, Northern Mixed Grass Transboundary Conservation Initiative, and its successor, Crossing the Medicine Line Network. While these initiatives share the common objective of fostering biodiversity conservation across boundaries, there are differences between them involving varied historical and cultural backgrounds, legal, and regulatory regimes. Nature does not recognize county, state, tribal, governmental, or international borders, thus transboundary collaboration is essential to successfully achieving common conservation objectives.

The Swan Valley Grizzly Bear Conservation Agreement: A Case History of Collaborative Landscape Management

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The Swan Valley Grizzly Bear Conservation Agreement (SVGBCA) was initiated in 1995 between the USDI Fish and Wildlife Service, Flathead National Forest, Plum Creek Timber Company and the Montana Dept. of Natural Resources and Conservation to address grizzly bear habitat management concerns on ~ 370,000 ac of intermingled ownership located between the Mission Mountain and Bob Marshall Wilderness areas in northwestern Montana. The general objective of the SVGBCA is to implement a multi-landowner management plan that would contribute to the conservation of grizzly bears (*Ursus arctos horribilis*) while still allowing cooperating landowners to realize the economic benefits of their lands. The specific biological goals are to maintain connectivity between the Bob Marshall and Mission Mountain wildernesses and minimize the risk of death or injury to grizzly bears using suitable habitat within the valley. The general conservation approach is to designate linkage zones to

facilitate bear movement between wilderness areas, rotate forestry activities in the landscape to minimize disturbance, limit open road densities, and implement habitat management guidelines at the landscape and site-specific levels. Research and monitoring was initiated in 2002 with the inclusion of MDFWP in telemetry studies of grizzly bears using the SVGBCA. Detail on SVGBCA implementation and effectiveness monitoring is presented. Key findings are that connectivity objectives are being met regarding both east-west connections between the wilderness areas and north-south movements between important habitats outside the Swan Valley. Bears stayed in the Swan Valley generally, with little altitudinal migration. Grizzlies used all ownerships in the valley and habitat use varied between nocturnal and diurnal activity periods. High levels of mortality were documented in 2003 and 2004. Landownership changes within the 15-year-old SVGBCA resulting from the Montana Legacy Conservation Land Sale are discussed.

General Abstracts

Alphabetical by First Author's Last Name

(* Denotes Presenter)

Epidemiologic Findings And Management Response During A Bighorn Sheep Die-Off In The Elkhorn Mountains Of West-Central Montana

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Bighorn sheep (*Ovis canadensis*) were introduced into the Elkhorn Mountains of west-central Montana in the mid 1990s. The population increased in number to approximately 250 animals until the winter of 2007-2008 when about 84 percent of the population died from a pneumonia related epizootic. Management actions during the die-off were geared toward removing as many sick animals as possible in efforts to reduce overall mortality. Due to the stage of the epizootic removal of sick sheep was not effective in interrupting the die-off. Samples were collected from bighorn sheep, domestic sheep, mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*) and domestic goats utilizing the same winter range. Pasteurella spp, Moraxella ovis and Mycoplasma ovipneumonia were isolated from lung tissue of dead bighorns and pharyngeal swabs collected from domestic sheep occupying similar range during the epizootic. Both the bighorn sheep and domestic sheep also shared similar gastro-intestinal parasites including Nematodirus spp and Eimeria spp. Testing tissues and fecal samples from sympatric mule deer suggested no shared bacterial pathogens and limited shared gastrointestinal parasites. Evaluation of fecal samples from domestic goats and elk also occupying bighorn sheep range identified few shared parasites that may have contributed to the epizootic.

Brucellosis in the Greater Yellowstone Area: A Multi-State Issue with Varying Management Paradigms Influencing Management and Possible Eradication of the Disease in Wildlife

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Brucellosis, caused by the bacteria Brucella abortus, is an infectious disease of cattle, bison (*Bison bison*) and elk (*Cervus elephus*). The Greater Yellowstone Area (GYA) is the last known reservoir of the disease in the lower 48 states. Recent cases of the disease in cattle herds of Idaho, Montana and Wyoming have been attributed to exposure from wild elk and have brought increased focus on management and eradication of the disease from wildlife populations. Elk management programs within the three states of Idaho, Montana and Wyoming differ in response to the disease. Efforts to manage the disease within the GYA are greatly influence by management actions taken within individual states. The differing management actions and the potential influence on brucellosis management and possible eradication are discussed.

Status Review and Conservation Initiatives for American Bison: A Continental Perspective

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Five hundred years ago, there were tens of millions of American bison (*Bison bison*) roaming free on the plains of North America from Alaska to northern Mexico. The decimation of the American bison in the late 1800s inspired the first recovery of bison and an entire conservation movement that protected wildlife and wild places across North America. As of 2008, there were ~ 400,000 bison in commercial herds in North America, some 93 percent of the continental population. There were 61 plains bison conservation herds containing ~ 20,500 animals, and 11 conservation herds of wood bison, containing nearly 11,000 animals. Little progress has been made in recent decades to increase the number of animals in conservation herds. Many factors affect survival of bison populations, including limited habitat and severe winters. Yet, the greatest challenge is to overcome the common perception that the bison, which has had a profound influence on the human history of North America, socially, culturally and ecologically, no longer belongs on the landscape. The key to recovery of this species is recognition that the American bison is a wildlife species and needs to be conserved as wildlife. Recently a new conservation strategy was developed by the IUCN bison specialist group and a new vision for the ecological restoration of bison was described by the Wildlife Conservation Society under our American Bison Society initiative. A new Continental vision for the American bison is inspiring a second recovery and helping to restore functional grassland ecosystems.

Life on the Fringe: Muskoxen in the Alaskan Arctic

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The Arctic is experiencing some of the most dramatic temperature changes on the planet. Species at the edge of their range often confront conditions that differ from those in the center–to the extent that the persistence of peripheral populations might be more challenged if bioclimatic factors rule. An indisputable Arctic-adapted species are muskoxen (*Ovibos moschatus*) which occur at their historic southwestern terminus in Arctic Alaska. We instigated a multi-year project to assess sources of variation in demography, attendant life-histories, and vital rates by contrasting populations on National Park Service and adjacent lands at Bering Land Bridge and Cape Krusenstern. A major challenge of Arctic work is expense; in lieu of handling large numbers of animals, we present a simple non-invasive method to predict body mass in young and sub-adults. We used photogrammetry to document head sizes at known distances and angles on more than 300 wild muskoxen from four age cohorts(1 to 3 yrs, and older). With head size parameters calibrated on captive individuals, 85 percent of the variance in body mass was explained for animals < 4 yrs of age. Accuracy diminished at > 65 meters and as animals reached puberty, the latter because nutrients allocated for skeletal growth are re-directed to meet reproductive demands. We believe that our ability to associate changes in mass/yr with abiotic and biological factors and survival will enhance opportunities to test hypotheses about causes and correlates of variation in population persistence.

Human Influences on Elk Movement Rates and Resource Selection in the Wildland-Urban Interface.

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Elk (*Cervus elaphus*) are known to select for refuge from hunting by humans (elk hunting). In many areas in the western U.S., elk hunting is completely excluded in the wildland-urban interface (WUI) as a result of land ownership change and subdivision, thus providing refugia for elk. Many of these WUI elk populations are increasing rapidly, and pose a significant credibility challenge to wildlife managers. The North Hills Elk Herd, in Missoula, Montana, has been growing at ~11 percent since the early 1980s, and the herd now numbers over 300 animals. Landownership is a complex matrix of public and private lands that range from partial to complete exclusion of hunting, thus elk hunting pressure is low and provides multiple refugia. Montana Fish, Wildlife and Parks used elk hunting in this setting to reduce population growth, crop depredation, and habituation. Little is known about the

efficacy of elk hunting on elk movement rates and habitat selection. We used First-Passage Time (FPT) and Resource Selection Functions (RSF) analysis based on nine GPS collared adult female elk during three hunting seasons with increasing hunting pressure (2007-2009) to test relationships between elk movement rates and resource selection in the WUI. Elk FPT decreased annually, if they were accessible, and differed by hunting mode and season. Elk selected for intermediate distances from homes, trails, and weakly avoided access. These data have been used to modify hunting season structure, acquire conservation easements, and develop lasting partnerships in a complex matrix of ownerships.

Mapping Brucellosis Increases Relative to Elk Density using Hierarchical Bayesian Models

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The relationship between host density and parasite transmission is central to the effectiveness of many management strategies. We applied hierarchical Bayesian methods to an 18-yr dataset on elk (*Cervus elaphus*) brucellosis in the Greater Yellowstone Ecosystem (GYE) and found that increases in brucellosis seroprevalence were strongly correlated with elk densities. Elk that were densely aggregated on supplemental feeding grounds had higher seroprevalence in 1991, but by 2008 many areas distant from the feeding grounds were of comparable seroprevalence. Thus, brucellosis appears to be expanding its range into areas of higher elk density, which is likely to further complicate the United States brucellosis eradication program. The data could not differentiate among linear and non-linear effects of host density, which is a critical area where research can inform management actions. This study is an example of how the dynamics of host populations can affect their ability to serve as disease reservoirs.

Management Challenges from Predator-Prey Effects on the Gallatin Canyon Elk Herd

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The Gallatin Canyon elk (*Cervus elephus*) herd northwest of Yellowstone National Park (YNP), is among the most historic and heavily-researched herds in Montana. Counts, classifications, and harvest records extend from 1919 to present, with intensive wolf-elk research conducted over 2001-2006. The herd remained remarkably stable for more than 80 years, averaging ~1900 wintering elk from 1919-1985. After a data gap spanning 1985-

1996, wintering elk counts showed alarming declines, with an average of 960 wintering elk counted over 1996-2010 and 511 counted in 2010. We used harvest records, aerial surveys, and telemetry on elk and wolves (Canis lupus) to determine mortality/predation rates and elk numbers, movements and distribution. From these data we developed a variety of population models to quantify effects of wolf predation and hunter harvest on elk in the Gallatin Canyon. Closed population models suggested a yearly elk population decline of 1-15 percent, whereas open population models suggested a decline of 30 percent, indicating losses due to deaths and emigration. Predator-prey ratios in the Gallatin are among the highest recorded in Montana, similar only to the unhunted elk populations of the Madison Headwaters (YNP). Like the Madison Headwaters, the Gallatin elk herd showed declines from direct predation and emigration loss. matrix models suggested hunting has a negligible population effect compared to predation, yet hunting is the only factor MFWP is currently able to moderate. We are left with a management paradox: hunting is not sustainable in this declining population, yet cessation of hunting will not reverse the elk population declines and will eliminate a treasured hunting opportunity that some families have enjoyed for generations.

Linking Landscape Characteristics to Local Grizzly Bear Abundance Around Glacier National Park

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Grizzly bear (*Ursus arctos*) habitat use has been extensively studied, but habitat has rarely been linked to demographic parameters and habitat models have not accounted for variation in detection or spatial autocorrelation. We collected bear hair from bear hair traps and rub trees in and around Glacier National Park (GNP) in northwestern Montana and genotyped the samples to identify individuals. We developed a hierarchical model with 1) explicit landscape and habitat variables that we theorized might influence abundance, 2) separate sub-models of detection probability for each sampling type, 3) covariates to explain variation in detection, 4) a conditional autoregressive (CAR) term to account for spatial autocorrelation, and 5) weights to identify most important variables. Road density and percent mesic habitat best explained variation in female grizzly bear abundance and the spatial autocorrelation term was not supported. Female abundance was higher where road density was lower and where more mesic habitat exists. Detection of females increased with rub tree sampling effort. Road density best explained variation in male grizzly bear abundance and the spatial autocorrelation term was supported. More male bears occurred in areas of low road density. Detection of males increased with rub tree and hair trap sampling effort and decreased with time. Our finding that road density influences abundance concurs with conclusions of earlier studies that road density influences habitat use.

Parallel Conservation Issues on Opposite Sides of the Earth: Montana Prairie Dogs and Tibetan Pikas

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Conservation issues often occur in patterns that are replicated spatially as well as temporally. While differing in detail as well as in cultural and regulatory background, issues surrounding conservation and management of black-tailed prairie dogs (*Cynomys ludovicianus*) in central Montana resonate strongly on the far side of the world in the case of plateau pikas (*Ochotona curzoniae*) on the Tibetan Plateau, People's Republic of China. Prairie dogs are well known for their role as ecosystem engineers, facilitating the existence of many other species, yet have faced persecution for decades and even now are only grudgingly provided acceptance by policy and regulation. Unlike in North America, most species of pikas in Asia are steppe dwellers whose presence and burrowing activity provides niches for a wealth of other species. Species for which plateau pikas provide needed habitat features vary from insects to passerine birds; species that depend on them as food sources vary from the small, e.g., (*Mustela altaica*), to the large (*Ursus arctos*). Both prairie-dogs and pikas have an obligate predator, i.e., black-footed ferrets here, Tibetan foxes (*Vulpes ferrilata*) there. Beginning in the 1950s, Chinese policy called for eradication or reductions of plateau pikas, labeling them pests in language similar to that more commonly seen in the context of urban rats. Poisoning campaigns have waxed and waned, but government policy remains antagonistic to pikas even within nature reserves. Both prairie dogs and plateau pikas are keystone species, but neither yet benefits from public policy that prioritizes ecological integrity over short-term expediency.

Land Mollusk Fauna of Montana: Biogeography, Conservation Status and Prospects

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Approximately 78 species of land snails and slugs have been reported for Montana, contrasting to 93 for British Columbia, 85 for Idaho, and 43 for Wyoming. Non-natives comprise 14 percent (4 snails, 7 slugs) of the total for Montana, 29 percent (13 snails, 14 slugs) for British Columbia, 19 percent (5 snails, 11 slugs) for Idaho, and 7 percent (2 snails, 1 slug) for Wyoming. Total native species for Montana, British Columbia and Idaho are nearly equal (67, 66, and 69, respectively), but only 40 for Wyoming, reflecting an overall drier and harsher climate. For Montana, 24 species (16 snails, 8 slugs) occur only west of the Continental Divide; the land snail fauna east of the Divide is 43 species, equal to the Wyoming total. Reflecting further the significance of western Montana for mollusk biodiversity, with its moister and more moderate climate, 15 of 24 exclusively western species (7 snails, 8 slugs) are Montana Animal Species of Concern, 5 of which (*Discus brunsoni, Oreohelix alpina, O. amariradix, O. carinifera, O. elrodi*) are Montana endemic snails. Land snails require cool and humid environments during their active season, microhabitats most prevalent in mature and old growth forests, riparian corridors, and around springs, but also present in large stable talus slopes. Many of these habitats are vulnerable to a variety

of human-caused and natural disturbances. Some western Rocky Mountain populations are currently considered conspecific with Pacific Northwest coastal populations; genetic analyses are needed to determine if these are sister species, similar to results obtained for several amphibian taxa.

Applying Novel Approaches to Old Datasets: Utilizing Opportunistic Observations to Describe Spatial-Use Patterns for the Steller Sea Lion Using a Bayesian Poisson Model

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This study utilized a dataset of opportunistic sightings to describe at-sea spatial use patterns for the endangered Steller sea lion (*Eumetopias jubatus*). Although opportunistic sighting data are often dismissed as unusable because of their lack of associated effort records, they often contain a wealth of information about a species' movement patterns and use of time and space. Such is the case with the Platforms of Opportunity (POP) dataset collected by the National Marine Fisheries Service. The POP dataset contains opportunistic at-sea marine mammal observations throughout the entire Pacific Ocean basin. In this study, a novel methodology was developed to overcome the lack of effort records associated with the POP observations and allow for calculation of effort-corrected Steller sea lion encounter rates in 15 km2 grid cells covering the species' entire range. A Bayesian Poisson model was used to quantify both the encounter rate and the uncertainty surrounding that rate in each grid cell. Spatial-use patterns specific to the breeding and non-breeding seasons were estimated along with overall year-round patterns. Prior to this analysis no range-wide spatially-explicit information about Steller sea lion habitat use existed.

Moving Beyond Niche Models: Habitat Suitability for Nesting White-Headed Woodpeckers

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Ecological niche models of habitat suitability are attractive due to their conceptual interpretation and use of presence-only data. Niche models have potential to exploit a variety of presence-only data sources, such as museum records, limited effort surveys, ancillary field observations, and citizen science programs. Limitations of niche models, however, substantially reduce their utility in management situations, in particular, the inability to independently evaluate habitat covariates for their relative influence. Generalized linear models, i.e., logistic regression, provide this ability, but require both presence and absence data. We present an approach that overcomes the limitation of niche models while retaining the use of presence-only data. The generation of pseudo-absences, derived from areas of low suitability as determined by the niche model, allow use of logistic regression to produce robust models of habitat suitability. The approach also has the added benefit of reducing contamination (false absences) among absence data that occurs with simple random sample approaches. We discuss the pseudo-absence approach in an example of modeling habitat suitability for nesting white-headed woodpeckers (*Picoides albolarvatus*).

Avian Influenza, an International Concern

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The spread of the virulent highly pathogenic avian influenza virus H5N1 Asian strain (HPAI H5N1) throughout Asia and into Europe and Africa since 2004 has resulted in the loss of millions of domestic birds and caused concern about its zoonotic potential. Though the significance of wild birds in the transmission of HPAI H5N1 remains unclear, wild birds are known to be the source of some outbreaks and can serve as an important sentinel for introduction of the virus to new areas due to expansive migration movements. The comprehensive HPAI H5N1 surveillance program, established in 2006 by the USDA and USDI Fish and Wildlife Service in cooperation with the states and tribes, monitors both wild and domestic bird populations to ensure the earliest detection of HPAI H5N1 incursion into the United States. Montana is a priority state in nationwide surveillance because it borders Canada and is divided by the Pacific and Central Flyways. Montana Fish, Wildlife and Parks, USDA/APHIS/Wildlife Services, and USDI Fish and Wildlife Service have conducted AI surveillance in Montana during the last 4 yrs using multiple sampling strategies to optimize the chance of detecting HPAI H5N1. Surveillance targets specific species spatially distributed across the state and temporally distributed across the sampling period. The primary emphasis on wild populations included systematic transects on populations of high priority for morbidity and mortality, along with opportunistically found dead birds, as well as the collection of swab samples from live and hunter-harvested waterfowl. Whereas low pathogenic avian influenza was found in samples each year as expected, no sample tested positive for HPAI H5N1.

Factors Influencing the Distribution of Riparian Breeding Birds along the Yellowstone River

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Riparian zones provide some of the most diverse and productive habitats for native birds in the western U.S. However, most riparian zones have been significantly modified by human activities. It is important to identify relationships between riparian birds and characteristics of the environment to understand the potential influences of floodplain management on birds. We examined the factors affecting riparian bird species distribution within cottonwood forests along the middle and lower sections of the Yellowstone River in Montana. We investigated the influences of local habitat, forest cover, and land use on the occurrence or abundance of 14 bird species. Furthermore, we considered whether geographical location along the river affected bird species distribution. There was strong evidence that these factors were important to birds, and the relative influences of each factor depended upon life history characteristics of each species. The effect of river location on the occurrence or abundance of species suggests that broad-scale influences may be important predictors of bird distribution along rivers. The

Yellowstone River is one of the few remaining free-flowing rivers in the lower 48 states, and may serve as a reference for understanding the factors influencing the distribution of birds along a river, and provide valuable information for the management of riparian species.

Culling as an Exploratory Field Technique to Reduce Overall Mortality During a Pasturella Spp. Outbreak in a Montana Bighorn Sheep Population

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Several herds of Rocky Mountain bighorn sheep (*Ovis Canadensis*) in the United States and Canada have experienced all-age die-offs during outbreaks of Pasturella spp. induced pneumonia. Isolating triggers and remedies for these die-offs remains elusive. Montana Fish, Wildlife and Parks used the statewide Draft Sheep Conservation Strategy as a guide in establishing a field culling-mobile laboratory-media response to a pneumonia/complex outbreak in the East Fork Bitterroot bighorn sheep herd. Montana Fish, Wildlife and Parks employees along with volunteers from the Ravalli County Fish and Wildlife Association, Wild Sheep Foundation and the USDA Forest Service culled 76 sheep from a herd numbering at least 187 animals according to spring 2009 aerial observations. Field personnel discovered six recent bighorn sheep carcasses when culling efforts began in late November. Field personnel discovered one additional bighorn carcass during the three-month culling process. Lab experts conducting onsite necropsies observed evidence of infection in 73 (96%) of the culled sheep. State biologists observed 93 bighorns on this winter range during a cursory aerial survey conducted on 28 December 2009. Preliminary observations from comparing results of sheep selected for culling to field necropsies suggest field personnel detect infected sheep with a high degree of accuracy. We suggest that this technique prevented additional mortalities directly related to pneumonia.

Stages of Habitat Structural Trend That are Related to Ungulate Browsing

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To maintain their structural identity, communities of tall-growing trees and shrubs depend on the growth of young plants to replace mature individuals that die. Ungulate browsing influences that structure by permitting or preventing the height growth of young plants. The resulting changes in structure are indicted by the browsing-related architectures of plants that grow within the browse zone, i.e., those ≤ 2.5 m tall. Using examples from six National Wildlife Refuges, we describe six stages of structural trend and their

management implications: 1) Structure is Stable, i.e., all plants have Uninterrupted-growth-type architecture; 2) Early Stage of Structural Decline most or all plants have Arrested- or Retrogressed-type architecture and there is no visible evidence of dieback; 3) Intermediate Stage of Structural Decline, i.e., all plants have Arrested- or Retrogressed-type architecture, dieback is apparent, and live stems extend throughout the lower half of the browse zone; 4) Advanced Stage of Decline, i.e., all plants have Arrested- or Retrogressed-type architecture and live stems are restricted to the lowest part of the browse zone; 5) Structure is Lost, i.e., no live plants; and 6) Recovery of Structural Diversity, i.e., there is evidence that the Early, Intermediate, or Advanced Stage of Decline existed, and that young Uninterrupted-growth type plants are growing into the browse zone. Three factors influence the rate-of-change from one stage to another: Susceptibility, Resistance, and Resilience. Because the stages are independent of species composition, they provide a means of comparing the effect of browsing in diverse habitats across a region.

Grizzly Bear and Black Bear Marking Behavior

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Marking activity is common among ursids but little information has been quantified about this behavior. We describe marking behavior of sympatric grizzly bear (*Ursus arctos*) and black bear (*U. americanus*) populations in a 31,400-km2 area in northwestern Montana. We found marking activity in all areas occupied by bears regardless of bear density and land use. Based on examination of > 5000 bear marking sites, rubbing was the most common behavior at these sites. We used genetic analysis of hair collected at rubs to identify species, sex, and individual identity of bears using them and remotely-triggered cameras to observe bear behavior. Both grizzly bears and black bears rubbed; 58 percent of rubs had black bear hair, 25 percent grizzly hair, and 11 percent hair from both species. Bears typically marked standing trees (86%) but sign posts on hiking trails and forest roads, and power poles were also used. Only males rubbed May-June but female use increased substantially by late summer. Although cubs were detected at lower rates than older bears, all grizzly bear sex and age classes participated in rubbing. Many sites were rubbed repeatedly within and between years but there was also continual turnover. One function of rubbing appears to be chemical communication among bears, although this behavior is different from marking behavior observed in territorial species such as canids. With the high frequency of rubbing activity in these sympatric bear populations, hair from bear rubs provides a reliable and efficient way to concurrently sample both species to monitor population trends.

Nesting Ecology of the Northern Goshawk in the Black Hills of South Dakota

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The nesting ecology of northern goshawks (*Accipiter gentilis*) was studied in the Black Hills of western South Dakota from 2003 to 2009. Goshawk nest territories were found by

broadcasting alarm calls, intensive searches of potential nesting habitat, and visiting historic nesting territories based on information from the USDA Forest Service. During this 7- yr period, 30 active goshawk nesting territories were studied. There were 53 nesting attempts sufficiently monitored to establish that 35 nests fledged young (66% successful). Among these monitored nests, there was an average of 1.1 chicks fledged/nesting attempt and 1.6 chicks fledged/successful nest. Goshawks frequently used alternative nests from one year to the next, and we were not always successful at finding new alternative nests. Alternative nests ranged from 50 yds to 0.7 mi apart. The average number of alternative nests found per nesting territory was 2.2, and in 1 territory there were six nests. Ponderosa pine (*Pinus ponderosa*) was the preferred nest tree with 65 goshawk nests in pine trees and one nest found in a white spruce tree (*Abies glauca*). The average diameter (dbh) of nest trees was 16.8 in dbh. Nest stand characteristics were measured at 21 nest tree sites. Average nest stand dbh was 10.2 in, average nest stand tree density was 266 trees/ac, and the average nest stand basal area was 128 ft^2/ac.

Predicting the Spatial Distribution of Human-Black Bear Interactions Across an Urban Area

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Human (*Homo sapiens*)-black bear (*Ursus americanus*) interactions are increasing throughout North America. Information that assists managers in developing methods to reduce conflicts is lacking. We used human-bear incident data, i.e., phone complaints and conflicts, collected in Missoula, Montana, by Montana Fish, Wildlife and Parks from 2003-2008 to describe the attractants and human impacts of incidents, and develop a model that predicts the spatial probability of incidents. We combined the locations of black bear sightings (n = 307), other incidents, e.g., bear seen feeding on garbage (n = 549), and sites where proactive management actions were carried out (n = 108), and compared them to 5000 random locations using logistic regression. Based on literature, we used distance to forested patches, distance to water, and housing density as variables in our model. Garbage (38%), fruit trees (10%), and bird feeders (7%) were the most common attractants at incident sites, and some incidents resulted in threats to human safety (9%) and property damage (7%). All variables were significant in the predictive model, and the model performed well at discriminating the relative spatial probability of incidents (rs = 0.782; $P < 0.01$). The probability of incidents increased when residents lived close to forested patches, close to water, and in intermediate housing densities (~ 6.6 houses/ha). Our results suggest that spatial patterns in human-black bear interactions are predictable and these patterns can be used to understand the potential for conflict in developing areas and to identify areas where preventative management is necessary.

A Method to Establish Trend Areas that Predict Pronghorn Populations to Guide Management Actions

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Trend area flights offer substantial cost and time-savings over total population counts, but trend area data need to be calibrated to total count data before they can be used with confidence in wildlife management decisions. To develop trend areas for pronghorn (*Antelopcapra americana*) in FWP Administrative Region 5, group location data from total surveys, for the period 1984-2009, were combined with classification information by hunting district (HD) into a GIS. Number of total counts conducted per HD varied from a low of six to a high of 13 and involved classification of between 364 and 8088 antelope. Grids, 5 mi x 5 mi to 12 mi x 12 mi (increasing by 1-mi2 intervals) in size were overlain on the pronghorn locations as potential trend areas. Number of yearling, adult and total bucks, does, fawns and total number by year, were calculated for each grid and cross-referenced with HD census data. The predictive ability of each candidate trend area was estimated and internally validated. We selected grids with the highest internally validated predictive ability to be used as trend areas for each HD in Region 5. Correlation coefficients between trend count data and total count data varied from a low of 0.88 to a high of 0.98. Newly established trend areas varied in size from 64.3 mi^2 to 216.6 mi^2. The time-savings and reduction in survey costs will allow biologists to fly surveys in each HD annually without sacrificing the ability to predict pronghorn populations accurately.

Winter Elk Distribution and the Risk Of Brucellosis Transmission from Elk to Livestock in the Northern Greater Yellowstone Ecosystem

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Predicting spatio-temporal variations in elk (*Cervus elaphus*) distributions is necessary to forecast the risk of brucellosis transmission from elk to livestock within the Greater Yellowstone Ecosystem (GYE). Using Global Positioning System (GPS) data collected from 49 telemetry-collared female elk during 2005-2006, we developed predictive resource selection function models for the brucellosis transmission risk period. To determine applicability of predictive models across the larger GYE landscape, we validated predictive models internally, as well as externally at two additional elk ranges within the GYE using 63 telemetry-collared cow elk during 2002-2009. Finally, we integrated extrapolated resource selection function maps and domestic livestock distributions to forecast elk to domestic livestock brucellosis transmission risk. We found elk distributions varied spatially and temporally during the risk period and predictive accuracy was highest in the study area where the model was developed. Predictive accuracy of extrapolated resource selection function maps was lower in other study areas indicating that risk models developed in one portion of

the GYE are not as accurate in other portions of the GYE. Relative to the other areas included in this study, the Madison Valley and northern Paradise Valley areas were predicted to have the highest risk of elk to livestock transmission risk. Predictions regarding spatio-temporal variations in transmission risk may be used to prioritize management actions aimed at reducing the potential for brucellosis transmission risk, for example hazing to reduce elk-livestock commingling or producer management of livestock distribution.

Pneumonia Outbreak in Bighorn Sheep in the East Fork of the Bitterroot: A Summary of Pathology and Laboratory Findings

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A bighorn sheep (*Ovis Canadensis*) pneumonia outbreak began in the East Fork of the Bitterroot River drainage in late November 2009. The decision to cull apparently sick animals provided the unique opportunity to collect fresh, high quality biological samples for diagnostic testing. It is our hope that information gained from this outbreak will contribute to an understanding of bighorn sheep pneumonia outbreaks in western states. The Montana Fish, Wildlife, and Parks wildlife laboratory performed full necropsies on many of the bighorn sheep that died or were culled during this outbreak. Body condition score and severity of lung lesions was noted. A fresh blood sample and fecal sample was collected, and the pharynx and ear canal were swabbed. Lung, tracheobronchial lymph node, and liver samples were also collected. Field personnel collected fresh tissue samples from culled sheep that could not be removed from the field for necropsy. Tissues and swabs were submitted to Washington Animal Disease Diagnostic Laboratory (WADDL) for aerobic and Mycoplasma culture. Serum and fecal samples were submitted to the Montana Department of Livestock laboratory in Bozeman. In this presentation we will describe the gross pathology of the pneumonia outbreak, summarize all laboratory findings, and describe similarities and differences when compared to other bighorn sheep pneumonia outbreaks within Montana and in other western states.

Combining Hunter Surveys and Territorial Dynamics to Monitor Wolf Pack Abundance and Distribution in Montana

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Carnivores are difficult to monitor on large spatial scales. We developed a patch occupancy model (POM) using hunter surveys to monitor gray wolves (*Canis lupus*) in Montana, and evaluated the ability of these models to provide wildlife managers with a time-and cost-efficient monitoring technique. We used hunter's sightings of wolves as our index of occupancy and explored how classifying a patch as occupied based on different minimum number of wolves sighted (1,2,3,4, or 5) or different minimum number of hunters sighting wolves (1,2,3,4,or 5) affected results. We also evaluated how our definition of a "patch" influenced the occupancy estimates by creating POMs with 3 different patch sizes that corresponded to the variation in wolf territory sizes in Montana. We ran multiple models with different patch sizes predicting occupancy classified according to different levels of minimum wolf sightings and minimum hunters seeing wolves. We assessed model accuracy by comparing POM estimates to the Montana Fish, Wildlife, and Parks (FWP) minimum wolf pack count. Our preliminary results showed that patch size did not strongly influence occupancy estimates and that a patch should only be identified as occupied if ≥ 2 to ≥ 4 hunters each observed ≥ 2 to ≥ 4 wolves in that patch. Within this range, FWP's minimum wolf pack count fell within the 95-percent confidence interval of POM estimates for 33 percent of the models.

Measures of Success: A Snapshot of the Montana Wolf Program in 2009

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Montana's gray wolf (*Canis lupus*) population continues to be secure, while the political and legal environments remain dynamic. Wolf delisting is a two-step process. Biological recovery criteria must be met and clearly demonstrated, along with an adequate regulatory framework. Secondly, the delisting decision must be upheld during inevitable legal challenges. The northern Rockies wolf population has met or exceeded numeric and connectivity requirements for many years. The northern Rockies gray wolf population was initially delisted in 2008, but a legal challenge reinstated federal legal protections under the Endangered Species Act mid-summer. By the end of 2008, Montana Fish, Wildlife and Parks

estimated a minimum of 497 wolves in 84 verified packs, 34 of which met the definition of breeding pair. Federal delisting efforts resumed early in 2009 and took effect throughout Montana on 4 May. The second delisting decision was challenged again in Federal Court, although a preliminary injunction request to reinstate federal protections was denied in September. With delisting in Montana, the wolf was automatically reclassified as a species in need of management. Montana's laws, administrative rules, and management plan also took effect. Montana Tribes lead wolf management activities on their respective reservations. The first fair chase wolf hunting season in Montana occurred in 2009. Seventy-two wolves were harvested through a quota-based framework. Wolves and their management continue to be controversial to a diversity of publics for a wide variety of reasons. Nonetheless, Montana's wolf program has a solid regulatory foundation and the population is biologically sound. This presentation will provide an update on a variety of topics.

Protection, Conservation, and Restoration of the Fort Peck Tribes' Manning Lake Wetland Complex on the Fort Peck Indian Reservation

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The Manning Lake Wetland Complex (MLWC), located on the Fort Peck Indian Reservation, is an incredible and unique landscape providing vital breeding and rearing habitat for a diversity of waterfowl, migratory birds, songbirds and other species, including at least 10 of conservation concern. The Fort Peck Assiniboine and Sioux Tribes and their partners have been working toward the protection, conservation, and restoration of the 22,000-ac wetland complex since 2004, when nine natural resource professionals from tribal, state, and federal agencies and programs formed a working group. Since then, thanks in part to grants from USDI Fish and Wildlife Service, Environmental Protection Agency, and Montana Audubon, great progress has been made toward reaching this goal. This presentation will introduce the Manning Lake Wetlands Tribal Wildlife Refuge and share our methods and accomplishments to date which include 1) designation of the Complex by Montana Audubon as An Important Bird Area; 2) Tribal establishment and management of 4000 ac as a Tribal Wildlife Refuge with plans to include additional acres in the future through purchase or long term conservation leases; 3) development of a habitat management plan and a wetland monitoring and assessment plan; 4) creation of a reservation specific wetland rapid assessment method; 5) creation of a baseline macroinvertebrate, bird, and amphibian species list; 6) development of water quality references; and 7) creation of habitat, vegetation associations, and land usage maps.

Passive Acoustic Monitoring for Bats in Support of the Coyote Wind Project, Sweet Grass County, Montana

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Wind energy development in the United States has been increasing rapidly and is expected to continue to do so. There are many benefits to producing wind energy; however

it is also important to understand potential negative effects and ways these impacts could be mitigated. Impacts to bats, and how to predict and mitigate impacts, are less well known than wind project impacts to birds. We conducted passive acoustic monitoring from 29 August to 6 November 2008 in Sweet Grass County, Montana, as part of pre-construction surveys for Enerfin Energy Company's proposed Coyote Wind Project. We deployed four Anabat acoustic detectors on two portable towers at 1.5- and 20-m heights, and recorded data nightly. We used these data to evaluate bat activity over the study period; within each night; relative to wind speed; relative to temperature; and relative to instrument heights. We recorded 668 echolocation files in 3 phonic groups. Bat activity was highest between 29 August and 1 October, and within 3 hrs of sunset. Bat activity peaked at wind speeds of 2-3 m/s and dropped off with increasing wind speeds to about 8 m/s. Bats were most active at air temperatures between 5 and 20 ^{o}C. Instrument height and bat phonic group were significantly correlated. These results are generally consistent with those found by Arnett et al. (2006) in Pennsylvania. Increasing our understanding of environmental parameters and bat activity in Montana will contribute to appropriate wind project siting and mitigation.

Evaluation of Bear Rub Surveys to Monitor Grizzly Bear Population Trends

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Wildlife managers need reliable estimates of population size, trend, and distribution to make informed decisions about how to recover at–risk populations, yet obtaining these estimates is costly and often imprecise. The grizzly bear (*Ursus arctos*) population in northwestern Montana has been managed for recovery since being listed under the U.S. Endangered Species Act in 1975, yet no rigorous data were available to evaluate the program's success. We used encounter data from 379 grizzly bears identified through bear rub surveys to parameterize a series of Pradel model simulations in program MARK to assess the ability of noninvasive genetic sampling to estimate population growth rates. We evaluated model performance in terms of: 1) power to detect gender–specific and population–wide declines in population abundance, 2) precision and relative bias of growth rate estimates, and 3) sampling effort required to achieve 80-percent power to detect a decline within 10 yrs. Simulations indicated that ecosystem–wide, annual bear rub surveys would exceed 80-percent power to detect a 3-percent annual decline within 6 yrs. Robust design models with two simulated surveys per year provided precise and unbiased annual estimates of trend, abundance, and apparent survival. Designs incorporating one survey/year require less sampling effort but only yield trend and apparent survival estimates. Our results suggested that systematic, annual bear rub surveys may provide a viable complement or alternative to telemetry-based methods for monitoring trends in grizzly bear populations.

Montana's First NRCS Cooperative Conservation Partnership Initiative: Restoring Ranchlands for Priority Birds in Eastern Montana

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The 2008 Farm Bill introduced the cooperative conservation partnership initiative (CCPI), a new initiative designed to leverage resources from outside the USDA to assist agricultural producers in coordinated efforts to address environmental challenges in their region. Proposed by the Environmental Defense Fund, locally-based Ranchers Stewardship Alliance, The Nature Conservancy and the World Wildlife Fund, "Restoring Ranchlands for Priority Birds in Eastern Montana" is the first CCPI supported by the Natural Resource Conservation Service in Montana. With Montana Fish Wildlife and Parks as a new partner this CCPI is dedicated to preserving one of the few remaining strongholds of untilled native grass and shrub lands in the plains of eastern Montana with the long-term goal of reversing the trend of declines among grassland birds. The CCPI covers over 300,000 acres of private lands within the 1.5 million ac landscape in South Phillips County, Montana. Private landowners will play a crucial role in conserving grassland birds by supporting the initiatives goal to increase habitat structural diversity over space and time on each participant's ranch. This will be accomplished through a combination of grazing and burning strategies and practices applied to promote structural heterogeneity in vegetation at varying scales. The CCPI will provide the technical and financial resources private landowners need to continue the kind of stewardship that sustains healthy habitat for priority grassland birds, and a healthy bottom line for their ranching operations.

Biologists and Biology in Montanagonia: Partners in Conservation at the End of the World

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The Montana-Patagonia Chapter of the Partners of the Americas in both Argentina and Montana was established during the 1980s. Rick Douglass, Department Head and Biology Professor at Montana Tech, has been largely responsible for keeping this volunteer organization active and viable for the last 20 yrs. The Partners of the Americas program was initiated nationally during the Kennedy administration. Each State in the U.S. is paired with a Central or South American Country. During the last 20 yrs a host of wildlife and fisheries biologists have volunteered to travel back and forth from Patagonia to Montana. Culture and education exchanges have focused on biology and have been completed in the areas of fisheries management, electro-shocking, wildlife survey and inventory, grazing systems, hunting systems, puma conflicts, environmental education and more. Patagonia biologists in Argentina have implemented groundbreaking research and management programs that have promoted the conservation of endemic species at the southern tip of the South American continent. Participation in the Partners of the Americas Program has enriched the careers and lives of professional biologists in both hemispheres.

From the Temperate Zone to the Tropic–Sun Bear Research and Conservation from Montana to Borneo

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Originally found throughout Southeast Asia, sun bears (*Helarctos malayanus*) are the least known bear and remain poorly studied. We initiated one of the first ecological studies of the sun bear in Sabah, Malaysian Borneo starting in 1998. This research has continued since then and has expanded to include conservation actions that respond to key findings. Our research documented the life history and ecology of the sun bear in the tropical rainforest and highlighted serious conservation concerns for the species. Sun bear numbers are decreasing in Borneo and the rest of Southeast Asia from habitat loss and illegal hunting for food and medicine. Poaching sun bears for body parts and capturing sun bear cubs for the pet trade has resulted in many orphaned sun bears. In addition to these direct human pressures, we documented the impact of environmental variability on sun bears in Malaysia when we observed an unusual famine event in Borneo in 1999-2000. Studied sun bears suffered from severe emaciation and even death. The famine event was related to abnormal climatic events of El Nino and La Nina Southern Oscillation that disrupted the mast fruiting activities in the forest. In response to the many conservation issues facing sun bears in Malaysia, Siew Te Wong founded the Borneo Sun Bear Conservation Centre (BSBCC) in 2008. The BSBCC aims to conserve sun bears by rehabilitating orphaned bears, providing long-term care for captive bears, conducting education and outreach activities, and serving as a base for sun bear research.

Subspecific Identification of Sharp-Tailed Grouse Samples from Montana

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Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) historically occupied much of the shrub-steppe habitat of the intermountain west, ranging from interior British Columbia south to California and Colorado. The subspecies has been extirpated from most of its range and currently exists in only scattered isolated populations. The last remnant populations in western Montana were located in the Tobacco Valley near Eureka and the Blackfoot Valley near Helmville. However, those populations were extirpated during the previous decade and the subspecies can no longer be confirmed in the state. A rangewide genetic analysis of sharp-tailed grouse in 2006 documented restricted gene flow based on an analysis of 45 tissue samples taken from Montana birds east of the continental divide. We extended that earlier analysis with a total of 133 tissue samples, including samples from western Montana birds extracted from museum skins collected in 1897, and compared these

samples to other genetic profiles reported from across the species range. We compared these samples to test for genetic differences in an area where the reported distribution of the Columbian subspecies is geographically near populations from the plains subspecies (*T. p. jamesi*). We were able to assign subspecies classification to 126 of the 133 Montana samples, including all samples from west of the Continental Divide. All Montana samples conclusively typed out to the Plains subspecies. Our analysis identified 3 similar genetic clusters across sharptail populations: (1) Alberta, Colorado, Montana, North Dakota, South Dakota and Nebraska, (2) Washington, British Columbia and western Idaho, and (3) Utah and southern Idaho. Both microsatellite and control region sequence data indicate that sharp-tailed grouse from all localities in Montana are molecularly most similar to populations from the plains regions of Alberta to Nebraska, indicating that Montana birds share a relatively recent molecular history. It does not appear that the Continental Divide is a current or historical barrier to gene flow in sharp-tailed grouse.