ABSTRACTS OF THE 2007 ANNUAL MEETING OF THE MONTANA CHAPTER OF THE WILDLIFE SOCIETY

DEVELOPING ENERGY, SUSTAINING NATURAL SYSTEMS: HOW DO WE DO IT?

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INTRODUCTION

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The Montana Chapter of The Wildlife Society is the professional association of biologist active in wildlife research, management, education, and administration within the State of Montana. The goal of the Chapter is scientific management of Montana's wildlife resources and their habitats. The principle objectives of the Society are: (1) to develop and promote sound stewardship of wildlife resources and of the environment upon which wildlife and humans depend; (2) to actively participate in programs designed to diminish human-induced environmental degradation; (3) to increase awareness and appreciation of wildlife values; and (4) to seek the highest standards in all activities of the wildlife profession. Society members are dedicated to sustainable management of wildlife resources and their habitats and ecology is the primary scientific discipline of the wildlife profession. The Society also believes that wildlife, in its myriad forms, is basic to the maintenance of human culture and quality of life.

To further explore the public trust in our times, the 2007 conference theme was Developing Energy, Sustaining Natural Systems: How Do We Do It? We toured the energy scene, including various types of energy development, the regulatory framework, wildlife/habitat impacts, and the long term forecast. What started as a pre-conference training workshop, Energy 101, continued into a series of special energy sessions throughout the main conference in unprecedented fashion, reflecting the importance of the topic and implications for Montana's wildlife. Featured speakers included professionals from Alberta and Wyoming who clearly demonstrated the challenges of balancing wildlife conservation and energy development. Other speakers working at the wildlife – energy interface covered topics including energy transmission corridors, wind development, coal development potential, sage grouse, bats, mule deer, and habitat mitigation strategies. The Plenary Session was a lively series of presentations that touched on a wide array of perspectives about energy development in Montana.

A second workshop entitled Building Connections between Wildlife Populations and People: The Application of Wildlife Linkage Across the Northern Rockies Landscape addressed the critical issue of how to assure movement opportunities for wildlife as human development proceeds, human populations increase, and energy resources are developed. A third workshop brought people together for a dialogue on children and nature: No Child Left Inside, Reconnecting Montana's Youth to Nature. Children today spend less time outdoors than

in past generations and that has important implications for ensuring conservation successes and instilling stewardship values in future Americans.

One of the featured speakers was Dr. Steve Running from the University of Montana, whose participation on the United Nations Intergovernmental Panel for Climate Change would garner the 2008 Nobel Peace Prize. His presentation was titled "Climate Trends and Ecosystem Responses in Montana." While science is a phenomenally slow process and uncertainty remains, Dr. Running challenged us to really think about climate change and its implications for Montana wildlife as we design protocols and collect data, make management decisions, and plan habitat conservation projects, among other things.

The Montana Chapter herein provides the abstracts of its 2007 Annual Meeting. Many reference ongoing research and management projects, and may include data that are not comprehensive or fully analyzed. Thus, abstracts should not be cited in other works without permission of the author(s), whose contact information is provided. Our next annual meeting will be held 26-29 February 2008: Northwest Connections: Sustaining our Wildlife Populations in the Face of Climate Change, Human Population Growth, and Energy Development.

A Blueprint for Energy Self-Reliance: How All of Montana's Energy Needs Can Be Met Using Conservation and Clean, Renewable Energy While Creating Jobs, Saving Money, and Revitalizing Rural and Urban Communities

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Montana stands at a crossroads. Right now, in 2007, efficiency combined with renewable, clean sources of energy cost less, and can be brought on line faster than any new sources of fossil energy. AERO's vision is that Montana can prosper with an energy policy based entirely on conservation and renewable resources. It is both technically and financially feasible to do this. We can grow our economy without damaging our air, water, land or quality of life—and without spewing further greenhouse gases into Earth's atmosphere. Doing this right means developing diverse and decentralized energy systems, creating meaningful work for our citizens, broadening local ownership of production and distribution systems, reducing our vulnerability to natural or human-caused disasters, and enhancing the resilience and well-being of our rural and urban communities. The first and by far the cheapest thing to do is efficiently manage energy demand, do more with less. Then do the rest with renewable sources of energy. AERO wrote the blueprint document to catalyze citizen participation in creating a sound statewide energy policy. The choices we face are political, not technical. It is our money and our environment. We can use Montana's renewable resources effectively to supply all of our state's internal energy requirements now and into the future. We prefer this to the conventional scenario of continuing as an energy colony, extracting non-renewable resources and shipping them out or, in the case of coal, burning it here and polluting our air, water and soil in order to create electrons to be transmitted elsewhere. We believe Montana's best contribution to the nation will be to assume a new role, as a regional model of clean energy, self-reliance and true "homeland" security.

Developing a Monitoring Framework for Wolves in Idaho

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Since wolf reintroduction, radio telemetry has been the primary tool for monitoring wolves in Idaho. However, its efficacy as the sole method for population monitoring will wane as the wolf population expands and federal funding for wolf management diminishes. Maintaining radio-collared wolves dispersed widely across the landscape is an expensive and logistically difficult monitoring approach. Few studies, however, have developed reliable alternatives for monitoring wolves across varied landscapes. We are evaluating the effectiveness of wolf population monitoring methods within four separate study areas in Idaho. One method, the summer scat method, stratifies habitat to facilitate sampling, provides data indicative of reproduction, and can provide estimates of wolf abundance. We are also testing the efficacy of hunter questionnaires and public sightings in estimating wolf abundance in the study areas. In addition, we are pilot testing several novel methods to detect and count wolves. To provide a statewide assessment of wolf distribution and abundance, we will collate data from tested non-invasive field methods, public observation data, and radio-collared animal data into an occupancy model. Preliminary analyses indicate an occupancy model using only public sightings can reasonably estimate number of wolf packs in Idaho. Development and refinement of such an occupancy model provides a framework for wolf population monitoring in the absence of, or complementary to, intensive telemetry-based monitoring. We expect our findings will be of interest and wholly applicable to professionals who manage wolf populations in other states.

Ten Years of Wolf-Ungulate Dynamics in the Madison-Firehole Drainage of Yellowstone National Park

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This study utilizes long-term research on a tractable and relatively unexploited wolf-elk-bison system in central Yellowstone, from 1996 to 2006, to investigate wolf recolonization dynamics, predation rates, and prey selection. Employing a combination of ground-based radio-telemetry and ground-tracking and monitoring methods, > 670 kills, 1400 locations, and 3200 km of tracking data were amassed from multiple wolf packs preying on a resident elk herd and a migratory bison herd. The ratio of wolves to ungulates is possibly the highest predator-prey ratio ever recorded, as wolf density, space use, and predation pressure in the study area increased dramatically before sharply dropping in the winter of 2006. Wolf use of the study area increased from a few itinerant wolves, to multiple established packs, before decreasing to primarily one pack. Elk comprised the preferred prey for wolves, and the ratio of preferred to alternative prey was predictably variable, both within and between winters, as bison migration

Deer movements across the highway corridor were obtained from deer mortality records of highway accident and carcass removal reports; and live deer highway crossing locations from an associated tracking study. A geographic information system was used to determine proportions of landcover variables within three spatially buffered layers centered on U.S. 93. Binary logistic and multiple linear regressions were used to evaluate models, and Akaike's Information Criterion (AIC) was used to rank models and variables. The results showed that landcover variables could be used to predict crossing or kill location. Top predictors included a positive correlation to forest cover, distance to the nearest city, and low intensity residential development. Negative correlations were found for distance to nearest water and population density. Results of this project will be used for comparison to post-construction movement patterns.

The Bird Community in Beetle Outbreak Areas: Surveying for Black-Backed Woodpeckers and Other Species

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Most avian distribution studies in Montanan conclude that black-backed woodpeckers are relatively restricted to post-fire areas. However, some studies elsewhere in the West have located black-backed woodpeckers in beetle outbreak areas. During the summer of 2006, the Landbird Monitoring Program, a collaborative effort between the Avian Science Center and the USDA Forest Service, surveyed for birds via point counts and surveyed for woodpeckers via broadcast callers to assess the bird community in beetle outbreak areas. We used GIS and grid-based, off-road sampling design to determine study sites and surveyed on five National Forests. We found very few black-backed woodpeckers associated with beetle outbreak areas. However, the bird community was varied and other species appeared to respond to the presence of beetles. Additionally, because the ASC also conducted a concurrent, near identical study in post-fire habitats, we compared detections of black-backed and other woodpecker species between these different habitats. We highlight these findings, discuss plans for upcoming field work, and provide details of current Avian Science Center happenings.

A Habitat Conservation Network Based Upon Focal Species: Design for The Inland Rainforest of North America

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A conservation plan should maintain ecologically functional populations of native plants and animals across large regions. In planning for the 194,799 km^2 Inland Temperate Rainforest (ITR) of British Columbia, Montana, Idaho, and Washington we focused on three animal groups: terrestrial wildlife, aquatic species, and birds. Terrestrial wildlife conservation requires core secure habitat large enough to maintain populations of large carnivores. These

species serve as umbrella species for other less sensitive animals. We developed terrestrial habitat suitability models for grizzly bear, wolf, wolverine, lynx, cougar, and mountain caribou. Results identify habitat cores for each of the six focal species that were merged into optimal composite cores to meet needs for several species. Optimized cores cover 102,326 km^2 or 52.52 percent of the ITR. Of this, 17,847 km2 or 17.44 percent of the cores was non-habitat. Habitat cores thus comprised 42.44 percent of the ITR. Least-cost-path connectivity methodology identified probable movement corridors between cores. Secondly we modeled aquatic species habitat based on the work of Chris Frissel. Optimal terrestrial wildlife cores included most of the best aquatic habitats. Highest quality watersheds mostly within the optimized cores added an additional 4,584.04 km2 of area to the network, or 2.35 percent of the ITR. Thirdly we used bird richness models developed by Andy Hansen to prioritize avian species habitat. Over 50 percent of the best avian habitats were included within the terrestrial core solution. This broad-scale habitat network comprised 44.79 percent of the ITR: this guides site-specific conservation solutions at finer scales which integrate into the overall design.

Contaminants in Eggs of Lesser Scaup Nesting on Lower Red Rock Lake, Red Rock Lakes National Wildlife Refuge

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North American lesser and greater scaup (Aythya affinis and A. marila, respectively) have declined at a rate of nearly 150,000 birds/yr for the last 25 years. Band recoveries indicated lesser scaup breeding in southwest Montana at Red Rock Lakes National Wildlife Refuge (Refuge) have one of the shortest migration routes of North American scaup (<1100 km), and winter in areas known to have elevated levels of contaminants. This led to concerns that contaminants obtained on wintering grounds could be negatively affecting scaup productivity on the Refuge. In 2006 lesser scaup eggs were collected on the Refuge from nests located in wetland habitats of Lower Red Rock Lake. Eggs were analyzed for organochlorine (OC; n = 25) and metal (n = 10) concentrations. Egg contaminant levels were regressed against initiation date to examine contaminant depuration rates during the breeding season. Only one OC analyte, p,p'-DDE, was detected in all 25 egg samples, four analytes were detected in 4-56 percent of the samples, and 17 analytes were not detected. Geometric mean concentration of p,p'-DDE was 286.0 ng g-1 dw (range = 81.9-17600.0 ng g-1 dw). For metals, selenium was found in all samples, mercury in 7, and arsenic, cadmium, and lead were not detected. Geometric mean concentrations of mercury and selenium were 0.1 and 1.2 µg g-1 dw, respectively. Concentration levels of OCs and metals were below levels known to affect productivity in birds, excluding one egg with an elevated p,p'-DDE concentration. No trends in depuration rates during the breeding season were found.

occurred. Considerable variation in wolf predation rates was also demonstrated, both within and across years and packs. Prey selection trends demonstrate that wolves are increasingly utilizing bison as prey, such that bison comprised the majority of wolf diets in winter 2006. The potential implications of this on future wolf-ungulate dynamics are addressed.

Do Natural Gas and Wildlife Mix? Evaluating Effects of Energy Development on Pronghorn in Western Wyoming

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The Upper Green River Valley in western Wyoming is home to > 100,000 wintering ungulates as well as 30-50 trillion cubic feet of natural gas. In 2005, we initiated a 5-year study to assess the effects of habitat loss, fragmentation, and human disturbance associated with gas-field infrastructure on pronghorn habitat use, movements, and demography. Data on survival, habitat use, and daily/seasonal movements are being collected with GPS collars (n = 50) that provide up to 8 locations/animal/day. Beginning in 2007, data from GPS collars will be supplemented with 100 VHF collars to provide more robust estimates of survival. In addition, we are contrasting correlates of reproduction such as body mass, stress hormones, and pregnancy rates between experimental animals that primarily winter in gas fields and control animals that reside in undeveloped areas, and are collecting data on bio-physical factors, e.g., snow depth, that influence pronghorn distribution. Preliminary results indicated that control and experimental animals had no differences in survival rates, body mass, or fecundity, suggesting that proximity to development has no detectable effect on pronghorn demography. Snow depth in excess of ~20 cm has an overriding influence on pronghorn use of local habitats. However, independent of snow depth, pronghorn tend to avoid areas that are fragmented by gas fields and roads, especially habitat parcels less than 600 ac in size. Ultimately, our results will enable industry and agencies to understand how energy-related footprints affect landscapes and population-level responses.

Road and Landcover Characteristics Affecting Deer Highway Crossings and Mortality along U.S. Highway 93 on the Flathead Indian Reservation, Montana, USA

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Animal vehicle collisions (AVCs) affect people and wildlife. On the Flathead Indian Reservation in western Montana, in an effort to reduce AVCs and increase highway safety, federal, state and tribal governments agreed to reconstruct the main highway through the reservation for the safety of travelers, but with considerations for cultural resources including wildlife. In this study we investigate road and land-cover characteristics associated with deer (*Odocoileus spp.*) collision and crossing locations preceding highway reconstruction efforts.

Predicting Heartwood Decay in Apparently Sound Western Larch for Snag Retention and Management

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Since many cavity-excavating birds require heart rot, managers routinely emphasize decayed trees in their snag retention prescriptions. Where too few trees are present with obvious indicators of decay, apparently sound trees are left to meet retention objectives. These trees may also contain decay, and may offer advantages in longevity and protection over more extensively decayed trees. Better information regarding conditions and heartwood decay-causing fungi important to heart rot in apparently sound trees would aid in retention decisions. We combined data from the 2003 Westside Reservoir and Roberts Fire burns with data from the USDA Forest Service Forest Health Protection's 10-year western larch (*Larix occidentalis*) merchantability study on the 2001 Moose Fire burn, all collected on the Flathead National Forest. We used dissection data from 284 apparently defect-free fire-killed western larch to predict the probability of heart rot related to tree age, diameter at breast height (dbh), elevation, aspect, habitat type, and heartwood-to-sapwood ratio. Fungi were isolated from trees with heart rot and identified through DNA analysis. We isolated *Stereum sanguinolentum, Echinodontium tinctorium, Sistotrema brinkmannii, Antrodia serialis, Phellinus chrysoloma*, and *Fomitopsis cajanderi* from trees in the three burn areas. All variables tested were significantly associated with probability of heart rot ($\mu = 0.05$), with age and dbh showing the highest predictive power through CART analysis. These preliminary findings support tree diameter as a critical characteristic in retaining trees most useable to wildlife, as well as retaining heart rot-causing fungi, which have undergone marked declines in other parts of the world.

Fish and Herpetofauna in the Powder and Tongue River Basin in Relation to Coalbed Natural Gas Development

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The Powder River Basin in Wyoming and Montana is currently undergoing one of the world's largest coalbed natural gas (CBNG) developments. Potential exists for substantial effects on riparian and aquatic ecosystems because CBNG development involves production and disposal of large quantities of coalbed ground water that differs from surface waters. We evaluated whether development affects fish and herpetofauna in the Powder River Basin in Montana and Wyoming. The purpose of the study was to determine if fish, amphibians, and reptiles were different in riparian areas of streams with and without CBNG development. We sampled 20 sites on eight streams in areas with development and 20 sites on eight streams in areas without development. Streams without development were deeper (*t*-test; $P = 0.04$), but the mean depth was only 8.4 cm deeper, which may not affect fish, amphibians and reptiles. Several fish metrics and an index of biotic integrity were used to compare fish assemblages in relation to the status of development within a drainage area. Streams in drainages with CBNG development on average had lower species richness than those without development. There were no significant differences between sites with and without

CBNG development in herpetofauna present (species richness, number of individuals, number of northern leopard frogs).

Sage Grouse Winter Habitat Selection and Energy Development

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The recent surge in energy development has resulted in rapid and large-scale changes to western sage-steppe ecosystems without a complete understanding of its potential impacts to wildlife populations. As part of a larger study investigating the impacts of coal-bed natural gas (CBNG) development on greater sage grouse (*Centrocercus urophasianus*), we modeled female winter habitat use in the Powder River Basin (PRB) of Wyoming and Montana to 1) identify landscape features that influence sage-grouse habitat selection, 2) assess the appropriate scales at which selection occurs, 3) spatially depict winter habitat quality in a geographic information system to aid in conservation planning and 4) assess the effect of CBNG development on winter habitat selection. Our findings highlight the need for landscape scale research to gain further insight into sage-grouse ecology. The strength of habitat selection between sage grouse and sagebrush was strongest at a 1000-m scale showing that the abundance of sagebrush over a landscape scale is an important predictor of use by sage grouse in winter. We generated a new index of topography "roughness index" which drastically out-competed all other topographic variables (wi ~1). Sage grouse avoided coniferous habitats and rugged landscapes at a 400-m scale. Our winter habitat model based on vegetation and topographic was validated by an independent data set of sage grouse winter locations (R^2 = 0.95). After controlling for vegetation and topography, the addition of a variable quantifying the extent of CBNG development within 1 km indicated that sage grouse in otherwise suitable winter habitat avoid CBNG development. This demonstrates that current strategies to mitigate impacts of CBNG on wintering sage grouse populations are insufficient. Our spatially explicit habitat prioritization tools, when coupled with knowledge of bird movements and active lek locations provide a biological basis for decision-makers to formulate an effective conservation strategy for sage grouse in areas undergoing energy development.

Bat Mortality at Wind Farms: a Summary of Recent Research Findings, and Management Implications for Montana Wind Power Development

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Bat fatalities at wind turbines have been documented worldwide, including North America. Annual mortality has been estimated to vary from < 2 to ~ 50 bats/turbine/yr. Hoary, red, and silver-haired bats appear to have the highest frequency of mortality. All three species are migratory forest bats, even though mortality of these species has been observed at wind turbines located in grassland habitats. Bats seem to be most vulnerable to collisions with turbines during fall migration periods. Bats are long-lived species that have low reproductive rates, and low levels of mortality could have potentially high impacts on local populations. Pre-construction bat survey protocols for evaluating potential wind energy sites will be described, including a review of current research efforts to evaluate the effectiveness of

pre-construction bat detector surveys for predicting bat fatalities. Post-construction wind farm monitoring protocols for documentation of bat mortality will also be reviewed. Effective bat mortality monitoring may require more frequent monitoring intervals than those often used for bird mortality. This presentation also summarized on-going research efforts by Bat Conservation International and others on potential mitigation measures and deterrents for bats at wind farms. A list of web resources will be provided for those who wish to stay informed about the latest information related to wind energy and bats.

Aerial Inventory Methods for Greater Sage Grouse

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Concern has been expressed over the status and well being of sage grouse (*Centrocercus urophasianus*) populations throughout their range; including southeastern Montana. The potential for large scale energy extraction and development across much of sage grouse range and its effect on sage grouse habitats and populations increases this concern. An accurate inventory of population resources and where these resources exist is critical to assessing population status. Successful mitigation of development impacts cannot occur without a comprehensive population inventory. Prior to 1999 there had been no systematic inventory of sage grouse populations in Southeastern Montana FWP Region 7. Sage grouse population monitoring consisted of annually surveying sage grouse lek activity on four trend areas and opportunistically monitoring incidental "known" leks and noting "new" lek locations. Sage grouse winter area monitoring consisted of noting areas of concentration along seasonally accessible roads. Until 1999 364 lek locations were identified within the 18,000 mi^2 of potential sage grouse habitat in southeastern Montana. Beginning in 1999 systematic inventories for sage grouse were initiated. The region made a priority of locating leks and winter areas in unsurveyed habitat across the region. Aerial survey methods were deemed the most appropriate and efficient approach towards this end. In the past 8 years 90 percent (16,000 mi^2) of the potential sage grouse habitat has been aerially surveyed and the number of known lek locations has increased to 827. Presentation centered on techniques and use of aerial survey for sage grouse population inventory and monitoring.

Pre-Construction Evaluation of Proposed Wind Power Developments

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Montana has a rich wind resource which could be potentially developed if transmission capability issues are resolved. Wind energy is promoted as a 'green alternative' to traditional sources such as fossil fuels and hydro. However, there is potential for impacts to locally breeding and migrating birds through collisions with turbines, and increased fragmentation of habitat. Pursuant to USDI Fish and Wildlife Service guidelines, a pre-development site evaluation should be conducted at all potential wind sites, to determine if wind power development is likely to cause avian (bird or bat) impacts at levels of concern. Working with agency,

academic and industry personnel, we have developed a Potential Impact Index (PII) to evaluate sites proposed for wind power development. The index incorporates physical attributes, species occurrence, and ecological characteristics to assess the potential for wildlife impacts by wind power development before construction. This presentation will include a discussion of the potential impacts of wind power development on birds, explanation of the PII, and its application to pre-construction studies in Montana.

Partitioning Human Impacts on Riparian Bird Distribution along the Madison and Missouri Rivers, Montana

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Conservationists, managers, and land planners are faced with a formidable task of needing to balance many issues regarding the impacts of humans on natural systems. While numerous investigations have documented a variety of impacts, from over-grazing to housing development, we know little about the independent effects of human impacts on biodiversity. This is unfortunate because managers and conservationists need such information to guide difficult decisions regarding where to allocate limited resources. Riparian forest habitats in Montana illustrate this problem, where many potential stressors can affect wildlife. We estimated the relative effect of anthropogenic stressors on birds using 105 riparian forest patches across three regions along the Madison and Missouri Rivers, Montana. We partitioned the effects of grazing, invasive plant species, habitat loss and fragmentation, and development and discuss the independent effects of each potential stressor on avian species richness and the occurrence of 35 bird species. For instance, grazing intensity, invasive plant cover, and under-story vegetation were all correlated, with high grazing intensity being positively correlated with invasive species cover, both of which were negatively correlated with the amount of under-story vegetation. Much of the effects on bird distribution can be explained by nesting and foraging substrates of these species. We end by providing recommendations on riparian forest management for Montana.

Evaluating Habitat Restoration Using Bird Communities: a Spatially Explicit Approach and Application to Aquatic Systems

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Habitat restoration is one of the only alternatives for conserving biodiversity in threatened landscapes. Biologists and managers are not only faced with restoring habitat, but also with the critically important task of evaluating the potentially widespread effects of restoration. Determining the success of restoration can be complex, however, because management can have a variety of effects on plant and animal communities. Here we describe the merits of using information on bird communities collected at landscape scales to evaluate restoration success. We illustrate this approach with an example from ongoing restoration at Odell Creek, a small stream located near the Madison River, Montana. We identify the following advantages to using bird communities for evaluating restoration success: 1) systematic data can be collected easily and less expensively than for other vertebrates, because birds are the most

visible and active vertebrates; 2) information can be rapidly gathered for dozens of species across broad spatial scales; 3) collective effects of restoration can be integrated into information on bird communities, such as effects on water quality, insect abundance, vegetation, or microclimate; and 4) the identification of effective indicators is highly probable because birds vary widely in their requirements and life history strategies. Furthermore, sampling designs that allow assessment of the spatial extent and magnitude of restoration effects can easily be implemented. Our approach should help act as a springboard for initiating future restoration on private lands, improving methods of restoration, and using existing data to predict restoration potential.

Influence of Post-fire Timber Harvest on Black-Backed Woodpecker Nest Survival and Nest Site Selection

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Post-fire timber harvest practices, i.e. post-fire salvage logging, on public lands are a highly contentious issue in the western United States. Harvest of burned trees impacts a number of species, particularly those specialized for using post-wildfire habitats. We assessed the effects of post-fire salvage logging on black-backed woodpecker (Picoides arcticus) nest survival and distribution within burned, mixed conifer forests of south-central Oregon. Multiple treatment and control plots were surveyed two years pre-logging (2003-2004) and two years post-logging (2005-2006). A total of 212 black-backed woodpecker nests were monitored during the four year post-fire period, with nest densities peaking in year three. Nest survival models containing temporal predictors (i.e. Julian date) performed better than those related to salvage harvest or other habitat features. Similar to previous studies, our results indicate that black-backed woodpeckers exhibit high overall nest survival (76.8%; range 67.9-83.6%) and select nest sites with higher snag densities than non-nest random sites. Nest survival and density appeared unaffected by salvage logging, contrary to our predictions. Upon completion, this project will supply agencies and managers with scientific data regarding post-fire habitat conservation for a sensitive woodpecker species.

Conserving the Plains Bison: an Unfinished Conservation Legacy

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Within the span of a few decades during the mid- to late-1800s bison (*Bison bison*) were reduced by hunting and other factors to a few hundred individuals. The plight of the plains bison led to one of the first major movements in North America to save an endangered species. Attempts to hybridize cattle and bison when bison numbers were low resulted in extensive cattle gene introgression in bison. Today, though approximately 500,000 plains bison exist in North America, few herds are free of cattle gene introgression. Small herd size, artificial selection, cattle-gene introgression, and other factors threaten the diversity and integrity of the bison genome. In addition, the bison is for all practical purposes ecologically extinct across its former range including Montana, with multiple consequences for grassland biodiversity. Urgent measures are needed to conserve the wild bison genome and to restore the ecological role of bison in grassland ecosystems. Socioeconomic trends in the Great Plains, combined with new information about bison conservation needs and new conservation initiatives by both the public and public sectors, have set the stage for significant progress in bison conservation over the next few years. We outline some of these new initiatives focusing on specific opportunities in Montana.

The Use of Fecal DNA to Describe the Genetic Population Structure of the Greater Yellowstone Area Bison with MTDNA

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Bison (*Bison bison*) populations of Yellowstone National Park (YNP) and Grand Teton National Park (GTNP) are the last remaining representatives of their wild, free ranging ancestors. Knowledge regarding population structure is crucial to their conservation, and may have important implications for understanding their ecology and evolution. Prior microsatellite studies of YNP bison captured outside of the park suggested the possibility of three subpopulations. An expanded assessment of population structure and gene flow between GYA bison populations through non-invasive fecal sampling, and the addition of mtDNA sequencing could provide further insight. Non-invasive fecal sampling has been used, with a high degree of success, in genetic studies of other ungulates. However, DNA amplification from fecal samples can be challenging and result in high genotyping error rates. Variation in fecal DNA quality and quantity, PCR amplification rates, and genotyping error rates from fecal samples has not been assessed in bison. We evaluated the feasibility of fecal DNA sampling for genetic analysis of wild bison populations. Variation in fecal mtDNA quality and quantity, PCR amplification rates, and sequencing error for bison fecal samples was evaluated. Sequencing of the bison mtDNA control region was used to evaluate haplotype diversity, population structure between breeding groups among YNP, and between GTNP and YNP bison populations. We found differentiation among breeding groups and a unique haplotype. Female philopatry may play a significant role in population structure and gene flow in naturally regulated, free ranging wild bison populations. Future studies using microsatellites could provide further insight.

Elk Behavioral Responses to Re-establishment of Wolves: the Indirect Consequences of Living in a Risky Environment

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It is well-documented that predators limit prey populations in many systems through the direct killing and consumption of prey. What is less well studied and understood are the indirect consequences of predators on the behavior of prey that are attempting to minimize predation risk. We conducted an intensive telemetry-based study of the Madison-Firehole elk (*Cervus elaphus*) herd and colonizing wolves (*Canis lupus*) in the central portion of Yellowstone National Park from 1991-2006 to test the prediction that wolves have altered various

elk behavioral responses including group size, winter home range size, activity patterns, and habitat selection. Prior to significant wolf reestablishment of the study area (1991-1997), we randomly collected approximately 6000 elk locations, representing 5000 elk groups with associated group size, activity budgets, and habitat selection attributes. These data are complimented by more than 5000 elk locations, representing 3500 elk groups and associated data when wolves had an established presence in the study system from 1998 through 2006. After wolf re-introduction elk that formally lived in a predator-free environment for many decades were subjected to varying levels of predation risk thus allowing us to investigate how these behaviors change at different temporal and spatial scales. Comparison of pre-wolf and post-wolf data demonstrates changes in elk behavior at a variety of spatial and temporal scales; presumably due to elk responses to predation risk. It is unclear whether these behavioral changes resulted in decreased individual fitness or reductions in population vital rates; however, we hope that continued monitoring will provide additional insights as this predator-prey system develops.

Effectors of Elk Summer Home-Range Size, Movement and Timing of Fall Migration

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For decades, research has emphasized the effects of roads, trails, and human use of the landscape on wildlife habitat availability and use. Historically, studies have assessed the impacts of human perturbations on the landscape by analyzing relatively infrequent VHF radio-tracking data or by track and fecal surveys. The deployment of 49 GPS radio-collars on adult, female elk (*Cervus elaphus*) in the Madison Valley, Montana during the winters of 2004-2005 and 2005-2006 provided opportunity to look at elk movement on 30-min intervals over the period of an entire year. Using the high-frequency of locations provided by these collars, we estimated the effects of roads and trails on elk summer home-range size, movement on 30-min intervals throughout the year, and factors influencing the timing of elk departure from their summer home-ranges and migration to winter ranges in the Madison Valley. Preliminary results from the first year of data suggest that various levels of human access influence elk movement differently at varying periods throughout the year, that there are regional differences in these effects, and that movement levels may not be a good indicator of home-range size. Varying levels of road and trail access during the hunting seasons appear to influence timing of elk departure from summer home-ranges, in combination with snow levels and regional differences. Collection of the second year of collars in February, 2007 will provide substantially more data and should help elucidate our understanding of influences on elk movement and behavior on a year-long scale.

Wildlife Meets Energy Boom

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The Upper Green River Basin is experiencing an energy boom beyond all expectations. The Pinedale Anticline and Jonah fields are considered among the top five gas producing fields in the U.S. Our nation's voracious appetite for natural gas leaves Upper Green River Basin area managers with the task of balancing world-class wildlife populations with developing world-class gas fields. Environmental impact analysis is challenged to keep up with rapid advances in technology and complex wildlife issues. Industry is currently proposing development on the Anticline beyond 2025, based on today's technology and estimated recoverable gas reserves. The effect of energy development on wildlife has already been significant. Wyoming Game and Fish Department has been working collaboratively with industry and surface managing agencies to address the issues. This presentation will reveal that there are no easy choices and most obstacles are formidable.

Conservation Planning along Montana's Front Range: Are We Conserving the Right Ecosystem Conditions?

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Conservation planning has at least two important levels that should be addressed if conservation objectives are to be met. The first level is ensuring that lands remain in uses capable of meeting the conservation objectives through purchases, easements, or other protection tools. The second level addresses if the existing conditions are appropriate to support the conservation objectives, and if not, what changes are needed. Montana's Front Range is recognized for its high conservation value and has seen considerable effort to protect these lands from development through easements. EMRI has been working with cooperating ranchers to assess the existing ecosystem conditions in a delineated planning area along the Front Range, and to compare these conditions to an historical reference. We developed a description of historical grass/shrub and riparian/wetland ecosystems in the area. We have conducted field sampling of vegetation for the past two summers to compare to the historical reference. The Front Range supports a very high diversity of plant species and is a critical area for many wildlife species. Preliminary results reveal that non-agricultural grass and shrub ecosystems are in good condition at the ecosystem level, but the riparian ecosystems have very high levels of exotic species. Management that returns fire to the grassland ecosystems and that reduces the levels of exotics in riparian areas is recommended.

Wolf and Elk Predator-Prey Dynamics in Banff National Park Alberta

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Wolves recolonized Banff National Park (BNP) in the early 1980s, and quickly regained their role as top carnivore for the primary prey species, elk. Research has established that wolf predation is an important limiting factor for elk and moose, and was correlated with significant elk population declines. Effects of wolf predation were also detected on other ecosystem components in a fashion consistent with a top-down trophic cascade. However, whether wolves can regulate elk to low density has not been addressed. I used wolf kill rates of elk, wolf and elk densities measured during winter from 1985-2005 to test whether wolf predation regulated elk to low densities. I fit simple prey dependent and ratio-dependent models to time series data to estimate the functional response of wolves to changes in elk density. I used linear and non-linear models to estimate the numeric response of wolves to changes in elk density. Model selection methods were used to select the best functional and numeric response models for wolves and elk. I then combined functional and numeric responses to estimate wolf predation rate as a function of elk density to identify dynamic equilibrium states. Evidence suggests wolves can regulate elk to low densities in this multiple-prey system where predator prey dynamics were largely driven by type II prey-dependent functional response and a Y-intercept in the numeric response. I compared kill-rates from Yellowstone National Park and other areas to model predictions, and discuss the generality of these results across wolf-elk systems.

Postcards from the Edge: A Snapshot of the Effects of Oil and Gas Development on Large Mammals in Alberta's Forests

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Energy development is the primary policy directive in Alberta, and as a result, oil and gas impacts a variety of wildlife species. We provide a brief scientific review of the effects of oil and gas development on large mammal species in forest ecosystems in Alberta. Oil and gas development can impact wildlife directly, for example through increased mortality or direct habitat loss, or indirect, mediated by changes in other species such as predators. Woodland caribou in Alberta are declining and three populations are at risk of immediate extirpation. Caribou suffer from direct loss of old growth forest from pipeline, road, seismic line and well site clearings, direct disturbance from seismic blasting, and increased poaching and highway

mortality because of increased access. Caribou also suffer indirect effects such as increased predator efficiency by wolves, which may increase predation rates. Grizzly bears suffer less from direct habitat loss, and can actually be attracted to increased forage production in disturbed areas. However, grizzly bears suffer the most from human caused mortality associated with increased human access. Elk are similar to grizzly bears, except they suffer the indirect effect of increased wolf efficiency with increasing development. Some species, such as white-tailed deer and coyotes, indicators of disturbed habitats, show signs of benefiting from oil and gas development, further altering ecosystem dynamics. Mitigation strategies for reducing negative effects of oil and gas are presented. However, a case study of the failure of the policy process in Alberta to mitigate these effects for caribou is presented, and recommendations for Montana were discussed.

Effects of Coalbed Natural Gas Development on Herpetofauna in the Powder River Basin

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Coalbed natural gas (CBNG) development is expanding worldwide, yet the full ecological impacts are unknown. Changes in water quality and surface disturbance associated with CBNG development have potential to alter the herpetofauna present. We evaluated whether development affects herpetofauna in the Powder River Basin in Montana and Wyoming. The purpose of the study was to determine if herpetofauna was different in riparian areas of streams with and without CBNG development. We sampled 20 sites on eight streams in areas with development and 20 sites on eight streams in areas without development. Streams without development were deeper (t-test; $P = 0.04$), but the mean depth was only 8.4 cm deeper, which may not affect amphibians and reptiles. There were no significant differences between sites with and without CBNG development in water quality (stream conductivity, dissolved oxygen, water temperature, pH) or herpetofauna present (species richness, number of individuals, number of northern leopard frogs).

Success of Grizzly Bear Population Augmentation in Northwest Montana

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The Cabinet-Yaak grizzly bear recovery zone is located in northwest Montana and northern Idaho. The population has been estimated to be 30-40 grizzly bears. The Cabinet Mountains portion of this area may be isolated from the remainder of the zone and was the site of a test of grizzly bear population augmentation. Between 1990 and 1994, four sub-adult females (2-6 yrs old) were translocated from the Canadian Rocky Mountains of southeast

British Columbia into the Cabinet Mountains. None of the animals involved had any history of conflicts with humans. The objectives of that experiment were to evaluate site fidelity, reproduction, and long-term survival of the translocated bears. Three of the four transplanted bears remained in the target area for 1 year or more and satisfied the short term goal for site fidelity. Recent genetic evidence gathered through hair snagging efforts have determined that at least one of the original transplanted animals remained in the Cabinet Mountains and has reproduced thereby providing evidence of success for the long term goals of survival and reproduction. This paper reports on the results of long-term monitoring of that experiment. We also report on our use of DNA hair-grab sampling to track survival and reproductive fate of one translocated female.

Aspen Height, Stem-Girth and Survivorship in an Area of High Ungulate Use

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An increase in an ungulate population potentially exposes aspen suckers, saplings, and trees to an increased level of use. This study examined how stem height and stem girth influenced the selection of stems by ungulates for browsing, rubbing, and gnawing, and reconstructed the history of ungulate use for the study area. Transects were run through each of three aspen clones growing on the Fleecer Wildlife Management Area to determine the height, circumference, and surface area of stems injured by rubbing and gnawing. Stems in the height range of 20 to 250-cm tall were browsed. Stems 2- to 13-cm diameter and greater than 80-cm tall were preferentially selected for rubbing and gnawing. The area of exposed xylem on dead saplings was 2- to 3 times the area of exposed xylem on live stems. There were no live stems in the 76- to 349-cm height range. Based on an analysis of stem height and age, ungulate use of the aspen clones was inferred to have increased from a light-to-moderate level to an intense level in the early 1990s. We concluded that elk were primarily responsible. The findings of this study have implications for aspen restoration programs and wildlife management. Where ungulate numbers are high and aspen is desired, aspen should be protected from browsing, rubbing and gnawing until stems reach about 13-cm diameter and have grown out of the browse zone. In this study area, aspen would require about 25 yrs to grow to that size.

Montana Wetland and Riparian Mapping Center

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A new wetland and riparian mapping center has been established for Montana that will map to USDI Fish and Wildlife Service (USFWS) standards using the National Wetland Inventory (NWI) and the System for Mapping Riparian Areas in the Western United States classifications. Unlike most of the U.S., the NWI was never completed in Montana and our equally important riparian areas also lack comprehensive mapping. All mapping follows USFWS quality control procedures and will be incorporated into the NWI national geodatabase after final USFWS approval. Mapping data will then be available to the public through

the USFWS NWI and the Montana Natural Resource Information System (NRIS) websites. Mapping is delineated on year 2005 1-meter resolution color infrared aerial imagery. Field verification follows to increase accuracy in problematic areas and to gather data about specific sites of high ecological significance (this data is entered into our Natural Heritage database). A guide to the vegetation, ecological functions, and management considerations of NWI types is located at our www.mtnhp.org website with additional information to be added as mapping continues. The mapping is dependent on partner funding and is ongoing in several areas of Montana with efforts to secure more funding underway. Contact Greg Kudray at gkudray@mt.gov or 444-0915 for additional information.

At-Scale Adaptive Management in Recovery Efforts for Piping Plovers on Alkali Lakes in North Dakota and Montana

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Recovery of threatened and endangered species requires managers to implement adaptive management at scales sufficient to reverse declines. The Great Plains population of piping plover was listed federally as a threatened species in 1985. Despite listing, the population continued to decline across the entire Great Plains until 1998 when the USDI Fish and Wildlife Service and the Conservancy, in cooperation with state game agencies and private landowners, implemented a collaborative management and monitoring approach. This effort, in combination with research on improving reproductive success and habitat quality, has resulted in population growth in 6 of the past 8 years for alkali lake-associated birds. Management to date has dealt primarily with addressing the primarily stress, altered predator communities. In 2005, we launched management that is designed to address the source of the stress by eliminating artificial predator habitat and restoring fragmented landscapes favorable to mesocarnivores. We also broadened the partnership for these efforts, gaining the financial support and focus of the Natural Resources Conservation Service. Results of this effort represent implementation of adaptive management at-scale through a multi-partner approach.

Does Enzootic Plague Affect Black-Footed Ferret Survival?

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Black-footed ferrets (*Mustela nigripes*) were first reintroduced in Montana in 1994 on the UL Bend National Wildlife Refuge and later on the Fort Belknap Indian Reservation and on Bureau of Land Management lands in Phillips County. More than 500 ferrets have been released and over 250 wild-born kits have been observed. Sixteen ferrets were known alive in Montana in October, 2006. Fundamentally, small and fragmented complexes of black-tailed prairie dog (*Cynomys ludovicianus*) colonies provide limited habitat. Sylvatic plague, caused by the bacteria Yersina pestis and vectored by fleas, can cause significant mortality in both prairie dogs and ferrets. The effects of epizootic plague are often dramatic with near 100 percent prairie dog mortality across hundreds of acres within weeks, eliminating both prey and habitat for ferrets. We hypothesized that enzootic plague, i.e. low, background levels of the disease, may also affect ferret survival. We conducted a manipulative, experimental investigation utilizing Deltamethrin dust to reduce flea populations and an experimental plague vaccine in ferrets. Survival of released ferrets and resident wild-born animals was monitored on comparable dusted and non-dusted prairie dog colonies. Half of all resident ferrets and half of all released animals were vaccinated against plague. Results from logistic regression analysis of data from 137 ferrets, spanning 222 survival intervals, provided the first direct evidence that enzootic plague decreases ferret survival. Plague and maintenance of sufficient habitat continue to present significant challenges for recovery of endangered black-footed ferrets.

Aspen Restoration by Beaver on Yellowstone's Northern Range

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Aspen (*Populus tremuloides*) on the Gardiner Ranger District of the Gallatin National Forest have declined in recent years. In 1991 beaver were reintroduced into Eagle Creek to stimulate aspen suckering and create more riparian areas. In 2005 a study was initiated to test the hypothesis that beaver increased aspen density and recruitment. We compared active beaver sites (n = 6), sites abandoned for 1-3 years (n = 7), sites abandoned for 4-6 years (n = 4), sites abandoned for 7-11 years (n = 5) and control sites which had less then 10 percent beaver utilization (n = 5). Thirty1-m2 plots were used to determine aspen density and one 60-m2

belt transect was used to calculate size class distributions at each site. Comparisons between sites were made using ANOVA for unequal sample sizes. Aspen densities in active sites and sites abandoned for 1-3 years were similar (2.6/m^2) and increased ($P = 0.01$) compared to all other sites (1/m^2). New sprouts and saplings were greater ($P = 0.01$) on active sites and sites abandoned 1-3 yrs compared to all other sites. Sites abandoned by beaver from 4-11 yrs failed to increase aspen recruitment. We concluded that beaver activity stimulated aspen growth, but ungulate herbivory prevented aspen regeneration in Eagle Creek.

Snowshoe Hare Abundance, Distribution, and Habitat Use in Glacier National Park

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Glacier National Park supports a population of the federally Threatened Canada lynx (*Lynx canadensis*), but little is currently known about their principal prey in Glacier, snowshoe hares (*Lepus americanus*), that makes it difficult to assess which habitats in the Park may be suitable for lynx. In summer 2005 we implemented a 3-yr study on snowshoe hare abundance, distribution, and habitat use in Glacier with a secondary objective of developing a non-invasive genetic sampling approach that could be of general benefit to National Parks initiating monitoring programs. Our data to-date suggested that snowshoe hare populations are patchily distributed throughout Glacier National Park. There was little or no evidence of hares in >60 percent of the forested sites we surveyed. The highest hare densities we recorded in the Park occurred near the Two Medicine area in the Park's southeast corner, and in the post-burn regeneration from the 1988 Red Bench fire in the Park's northwest corner. Snowshoe hare use of post-fire regeneration from the 1988 burns is highly variable. Although our two highest hare density sites occurred in these burns, half of our study sites in the 1988 burns had little or no evidence of snowshoe hares. A non-invasive genetic sampling approach shows potential for providing reliable hare density estimates in difficult-to-access areas of relatively high hare densities (>1 hare/ha). However, at the lower hare densities found throughout much of Glacier National Park, our current non-invasive sampling methods do not yield sufficient pellets for reliable mark-recapture density estimation.

Influence of Pack Size, Demography, And Human-Caused Mortality on Breeding Pairs of Wolves in the Northern Rocky Mountains

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The breeding pair is the reproductive unit within a wolf (*Canis lupus*) population, and is the legal and biological benchmark for wolf management. Management of the recovered wolf population in the northern Rocky Mountains (NRM) requires monitoring breeding pairs. Because pack sizes are easier to monitor than breeding pairs, we estimated the probability a pack would contain a breeding pair based on its size for wolf populations inhabiting six areas in the NRM. We also evaluated the extent to which differences in demography of wolves and levels of human-caused mortality among the areas influenced the probability packs of different sizes would contain a breeding pair. Probability curves differed among the analysis areas, depending primarily on levels of human-caused mortality and secondarily on population growth rate; population size and recent changes in population growth had little effect. Breeding pair probabilities were more uniformly distributed across pack sizes in areas with low levels of human mortality and stable populations. Probabilities were skewed towards large pack sizes in areas with high levels of human-caused mortality and high growth rates; small packs had little reproductive success. Our approach can be used by managers to estimate the number of breeding pairs in a population where number of packs and their sizes are known. Following delisiting of NRM wolves, human-caused mortality could increase, resulting in more small packs with low probability of breeding success; monitoring of breeding pairs will provide more accurate insights into population dynamics of wolves than will monitoring number of packs or individuals.

BLM's Development of an Approach to Monitoring Regional-Scale Impacts of Energy Development on Wildlife

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The USDI Bureau of Land Management's (BLM) monitoring related to wildlife and energy development is generally focused on compliance and effectiveness monitoring at the local lease level. This focus brings efficiency and direction to local energy programs, but does not allow monitoring of species and habitats at larger scales. Because many species have habitat requirements or ranges well beyond localities where energy development occurs, analysis of monitoring information should occur on a corresponding scale. BLM's regional-scale monitoring activities must involve shared information and application over multiple planning areas, Field Offices or State Offices. Regional information alone will not be sufficient to determine effectiveness of local mitigation measures, improve cumulative impact analysis, or track landscape changes over time. However, a comprehensive regional approach that incorporates local monitoring information can improve understanding of the circumstances under which land-use changes influence health and condition of expansive or dispersed habitats and wide-ranging species. The BLM is developing a process to monitor regional effects of energy (primarily oil and gas) exploration and development on wildlife species and habitats. BLM has contracted development of two regional monitoring approaches—in northwest Colorado and on Alaska's North Slope; each will be independently developed from a common theoretical framework. After completion of the contracted products, BLM will select the strongest elements to assemble and implement a single national program for regional wildlife monitoring. This regional approach could also be utilized in addressing cumulative impacts and species conservation planning in support of decision-making in land use planning, NEPA documentation, and ESA compliance.

West Nile Virus and Greater Sage Grouse

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West Nile virus (WNv) has emerged as a new issue in conservation of native avifauna in North America. Mortalities from WNv decreased survival of female greater sage grouse (*Centrocercus urophasianus*) by 25 percent across four populations in Wyoming and Montana, USA, and Alberta, Canada. Findings are troubling because survival of adult females is a limiting factor in population growth, and losses from WNv come at a time of year when survival typically is high. An outbreak of WNv in 2003 resulted in the local extirpation of a ~130-km^2 area in the Powder River Basin (PRB) in northeast Wyoming. In 2004 WNv spread to populations in Colorado and California, and female survival was 10 percent lower (86%) at four sites with confirmed WNv mortalities than at eight sites without. Mortality from WNv was ~2 percent in 2005 in the PRB in Montana and Wyoming, and decreased prevalence of infection and mortality in sage grouse, humans, and horses left many wondering if the worst had passed. Unfortunately, mortality from WNv increased again in 2006 in the PRB as hot temperatures returned, and three more states reported mortality for the first time (Oregon, Idaho and Nevada). In separate trials at the Wyoming State Veterinary Laboratory, all sage grouse

(n = 44) experimentally infected with WNv died in 6-8 days regardless of dosage, thus confirming extreme susceptibility to this disease. In 2003 and 2004 in the PRB, all live-captured birds tested seronegative for neutralizing antibodies to WNv. In spring 2005 and spring 2006, 10.3 and 1.8 percent, respectively, of newly-captured females tested seropositive and represented the first documented cases of sage grouse surviving infection with WNv. However, a consistent pattern of low WNv-related mortality in summer followed by low seroprevalence the following spring in all years suggests that, to date, only ~14 percent of sage grouse in the PRB have been infected. Naturally low infection rates and survival of sage grouse following WNv suggested that most sage grouse in the PRB have not yet been exposed to the virus and remain susceptible. For sage grouse, severity of future WNv epizootics in the PRB will likely depend more on temperature and changes in vector distribution than on resistance to disease. Until we better understand epizootiology of WNv in sage grouse habitat, we suggest that management to reduce its impacts focus on eliminating man-made water sources that support breeding mosquitoes known to vector the virus.

Impacts of Oil Exploration and Production to Waterfowl Production Areas Managed by the USDI Fish and Wildlife Services Northeast Montana Wetland Management District (WMD)

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The Northeast Montana Wetland Management District (WMD), manages 44 Waterfowl Production Areas (WPA). Mineral estates were reserved when these parcels were purchased resulting in numerous oil wells on WPAs (several WPAs have wells located ≤ one half mi of a WPA wetland). These WPAs are located in the continuation of the prairie pothole region of the Dakotas, as well as the Williston Oil Basin, which is Montana's top oil producing area. The dominant waste product from the oil production process is produced water, and this basin contains some of the most saline water in the United States, often > 300,000 µs/cm specific conductance. Disposal of drilling wastes and produced waters occurred in unlined reserve pits until the late 1970s when liners were required. Based on average pit size and conservative chloride concentrations, an estimated 260 tons of sodium chloride salts are present in each pit. This research was conducted to address concerns over migration of salts from reserve pits into wetlands on WPAs. Produced water impacts were documented in half of 80 wetlands sampled on 23 WPAs. Saltwater plumes migrating out of reserve pits were delineated using an EM-31 soil conductivity meter and a Trimble GeoXT and mapped using ArcGis. Monitoring wells installed within the mapped plumes to determine water quality revealed that sodium chloride brines and to a lesser extent, trace elements and hydrocarbons had migrated out of the reserve pits. Further, some of these constituents migrated to nearby wetlands.

Habitat and Subdivision Growth Models for Predicting Past and Future Habitat Loss from Rural Subdivision Development

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Rural subdivision development is perhaps the greatest current threat to wildlife habitat in MT and throughout the west. In order to plan for these changes, it is important to identify existing significant habitat, determine where subdivision development will most likely occur, and determine how future development will reduce living habitat and connectivity for wildlife. Using Gallatin County, Montana, as an example, I used a suite of focal species models to categorize current wildlife habitat and coupled the output with a subdivision growth model developed by the Sonoran Institute to estimate changes from 1975 to current and to predict future losses from now until 2015 and 2025. The strength of the habitat models I developed for grizzly bears, elk, and antelope lies in their use as focal species to identify specific habitat assemblages and the scale of output. They are sensitive to placements of roads and structures and can predict how different configurations within subdivisions can influence habitat quality and permeability. This ability has been enhanced by vegetation classification of color orthophotos to produce more accurate and finer-scaled model output. Predictive changes using the growth model are at a quarter-section scale, summing up cumulative change and trends over larger areas. Tools such as these may be helpful for guiding the amount, specific configuration, and placement of growth, thus maintaining important areas and reducing wildlife-human conflicts.

Relationships among Moose Abundance, Willow Community Structure and Migratory Landbirds at Red Rock Lakes National Wildlife Refuge

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Critical relationships exist between vegetation structure and avian diversity and abundance. Browsing by herbivores can lead to changes in the structural heterogeneity and species composition of plant communities, resulting in decreased use of heavily browsed habitats by avian species. We assessed the current levels of browse by moose and resulting effects on composition and structure of willow communities on Red Rock Lakes National Wildlife Refuge in southwestern Montana. We also determined abundance and community composition of breeding landbirds in these habitats and related these to willow structure. Bird counts and vegetation sampling were conducted along two riparian corridors and one fen habitat during the summer of 2006. Measurements indicate current levels of moose browsing on the Refuge are low to moderate. Species composition of willow communities varied between riparian and fen habitats and contributed to differences in willow volume and structural heterogeneity. Five species of birds (Yellow Warbler, Common Yellowthroat, Lincoln's Sparrow, White-crowned Sparrow and Song Sparrow) were used for examining relationships between avian abundance and willow vegetation characteristics. Of these species, only White-crowned Sparrow and Yellow Warbler demonstrated habitat selection based on willow vegetation characteristics

quantified. Common Yellowthroat, Lincoln's Sparrow, and Song Sparrow were best predicted by habitat type. Thus, consideration of other habitat characteristics such as herbaceous cover and bare ground should be considered in future management objectives. Additional vegetation sampling in conjunction with improved monitoring of moose populations utilizing the Refuge will allow managers to make informed decisions concerning moose harvest limits and conservation of willow communities.

Idiot Wind: the Wisdom of Bob Dylan[1]

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Former Congressman Pat Williams told us at last year's Montana Chapter meeting that we—wildlife biologists in Montana—have won. As evidence, he stated that logging on public lands is down, that grazing isn't the issue it once was, and that economic growth in Montana is greatest near public lands and wilderness. I suggest and provide evidence that this could just as easily be evidence that we've lost—or at least are losing. In addition, global warming, resource shortages, oil and gas development, subdivision, human population growth, a volatile political climate, and lax zoning regulations challenge us today and will vex future generations of wildlife biologists. The North American Model of Wildlife Conservation is an excellent history of how we achieved success in the past and sometimes achieve success today but will be woefully inadequate, by itself, to address these and other emerging issues. New alliances with those sometimes viewed as traditional foes and first-time battles with those sometimes viewed as traditional allies will be necessary in the fight to save wild areas and wild things.

[1]"What's good is bad, what's bad is good, you'll find out when you reach the top. You're on the bottom." – Bob Dylan

The Effects of Highways on Elk Habitat in the Western United States and Proposed Mitigation Strategies

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The project's purpose was to assess the effects of highways in the Western United States on elk (*Cervus elaphus*) and elk habitat. Elk are an important wildlife resource in the Western United States and have significant social and economic values. Elk also are a focal species for most western state wildlife agencies and land management agencies. The authors quantified the existing direct and indirect effects pf highways on elk habitat on a state-by-state basis and propose mitigation measures based on the impacts. The results will have widespread implications to state wildlife agencies, land management agencies, transportation agencies, conservation groups and the general population that is concerned about elk conservation. The authors also quantified elk mortality on highways and provide recommendations to mitigate elk mortality, habitat loss and improve highway safety for motorists. The project was supported by the USDA Forest Service and Rocky Mountain Elk Foundation.

Climate Trends and Ecosystem Responses in Montana

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Although global warming trends are widely acknowledged around the world, substantial climate change is already occurring in Montana. The most obvious trend in Montana of the last 50 yrs is late winter warming and earlier spring snowmelt. This climate trend is generating longer growing seasons AND longer wildfire seasons. Impacts on Montana terrestrial and aquatic ecosystems are only now beginning to be noticed. This talk will summarize global, regional and Montana climate trends and some critical ecosystem responses now being detected, and speculate on where the biosphere will go from here.

The Role of the USDI Fish and Wildlife Service in Permitting Energy Development in Montana

Shawn Sartorius, Fish and Wildlife Biologist, USDI Fish and Wildlife Service, Billings, MT 59101

The National Energy Policy was codified in 2005 by the Energy Bill of that year. The goal of the legislation was to decrease U.S. dependence on foreign energy supplies by increasing U.S. production, efficiency, and use of alternative fuels. As part of the effort to increase domestic oil and gas production, an Energy Pilot Project was initiated to streamline oil and gas exploration and production permitting on Federally owned mineral estate. This project provided money to key BLM Field Offices in the West for staff that would be dedicated to permitting oil and gas projects in a timely manner. Money was also appropriated for personnel in supporting agencies with regulatory authority over oil and gas projects. The USDI Fish and Wildlife Service has added staff, often co-located in USDI Bureau of Land Management (BLM) Field Offices to coordinate endangered species consultation and other aspects of wildlife management required by statute. In Montana, there are numerous challenges facing wildlife and land managers in the Powder River Basin of southeastern Montana as they cope with increasing extraction of coal bed methane gas reserves. The USDI Fish and Wildlife Service continues to engage with all interested parties to find solutions to these complex challenges.

Evaluating Impacts of Natural Gas Development on Mule Deer in Western Wyoming

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Increased levels of natural gas exploration, development, and production across the Intermountain West have created a variety of concerns for wildlife populations and their habitats. In July of 2000, the USDI Bureau of Land Management approved development of 700 producing wells, 400 miles of access roads, and 276 mi of pipeline to develop gas reserves in the Pinedale Anticline Project Area (PAPA). The PAPA provides important winter habitat to 4000-5000 mule deer that summer in portions of four different mountain ranges of northwest Wyoming. We used a variety of data collected prior to and during gas development to examine the potential impacts of natural gas development on mule deer in the PAPA. We discuss results from the first 5 years of gas development, including 1) estimated acreage and sources

of direct habitat losses, 2) changes in mule deer habitat selection patterns and indirect habitat losses, and 3) population performance of mule deer in the PAPA. Through 5 yrs of gas development we documented: 1) > 1,300 acres of direct habitat losses to access roads and well pads, 2) changes in deer distribution, i.e., avoidance of gas wells, and 3) a 45-percent reduction in mule deer abundance. Our study suggests that habitat selection patterns and population performance of mule deer wintering in the PAPA have been affected by natural gas development. Mitigation measures designed to minimize impacts to wintering mule deer should consider development strategies that reduce direct habitat losses (e.g., directional drilling) and human activity, e.g., fluid collection systems. Further, reducing disturbance to wintering mule deer may require approaches that limit human activity during both production and development phases of wells.

Assessing Fisher Distribution and Connectivity in The U.S. Rocky Mountains Using Non-Invasive Genetic Sampling

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In 2004 the USDI Fish and Wildlife Service responded to a petition to list the West Coast Distinct Population Segment (DPS) of fishers under the ESA. They ruled that the West Coast DPS was "warranted, but precluded" by higher priorities. Fisher are apparently rare in the West Coast, yet they are common in the Northeastern and Midwestern portions of the United States; over 2000 fisher are legally trapped in Maine, New York, and Minnesota each year. In the Rocky Mountains, the only other area of the United States that has fishers, there is little information regarding their distribution and population status. Idaho confers fisher its highest level of protection by listing the species as "critically imperiled" and a Species of Greatest Conservation Need under its Comprehensive Wildlife Conservation Strategy. Given recent management concern regarding fishers, multiple agencies, institutions, and organizations have recognized the need to obtain some basic information in the Rocky Mountains. Of primary interest is determining the geographic range of this species within the Rocky Mountains. Current available maps are either too general, e.g., brushstroke maps, and thus contain habitat that is not currently occupied by fisher, or are based on untested habitat relationships or unscreened sighting data. This talk will describe a large-scale, multi-institution effort currently underway to delineate the geographic range of fisher using non-invasive genetic sampling. In addition, preliminary genetic data on the population structure of fishers in the Rocky Mountains will be presented.

Survival Costs of Reproduction during the Hunting Season in Greater Sage Grouse: a Case Study in Central Montana

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Direct investigation of how harvest affects population vital rates and population growth, and the magnitude of harvest effects relative to other sources of mortality, is needed for informed management of harvested species. Greater sage grouse (*Centrocercus urophasianus*) are a species of concern and are still legally harvested in most of their current range,

including Montana. Due to uncertainty about the impact of harvest on vital rates and about the relative importance of harvest compared to other sources of mortality for sage grouse, we implemented a case study to simultaneously compare survival rates between adjacent hunted and nonhunted sites and to evaluate nonhunting factors influencing survival during the hunting season. We monitored the reproductive activity, survival rates, and causes of mortality of females using radio-telemetry in central Montana during 2004 and 2005. We included year, within-season variation, site, female age, and the cost of reproduction as covariates in our survival analysis. Female survival during the hunting season was lower for females with greater reproductive investment, and females on the hunted site had lower survival than females on the nonhunted site. However, lower survival rates on the hunted site could not be attributed to hunter kill, because no radio-marked females were bagged or reported by hunters and no evidence of hunter kill was observed. During this study, harvest appeared to be low in central Montana and appeared to have little impact on the population, especially relative to other mortality causes that were identified. Our results indicated costs of reproduction to survival.

Distribution of Swift Fox in the Proposed Valley County Wind Energy Project Area in Northeast Montana

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The initial stage of developing mitigation measures to minimize the impacts of energy development to wildlife is determining their distribution and abundance within the project area. We conducted a swift fox mark-recapture survey in the proposed Valley County Wind Energy Project (VCWEP) and surrounding area located approximately 30 miles north-northwest of Glasgow, Montana. Previous surveys have shown that swift fox have expanded into north-central Montana from Canada following reintroductions in southern Alberta and Saskatchewan. However, the extent of swift fox distribution within the proposed VCWEP and surrounding area was unknown. In 2005 and 2006, we systematically trapped 6 townships using Tomahawk live traps. We captured 4 swift fox in 2005 (2 adult males, 1 adult female, and 1 juvenile female) and 32 swift fox in 2006 (9 adult males, 10 adult females, 8 juvenile males, and 4 juvenile females) with capture rates of 1.3 percent and 14.5 percent, respectively. Within the VCWEP wind turbine footprint, we captured two swift fox in 2005 and six swift fox in 2006. This study determined that swift fox occupy the proposed VCWEP and surrounding area and provided information to aid the development of mitigation measures. The difference in capture rates between the two study years emphasizes the importance of multiple years of predevelopment data.

Off-Site and/or Compensatory Mitigation in Relation to Large Scale Development

Dan O. Stroud, Habitat Mitigation Biologist, Wildlife Division, Wyoming Game and Fish Department, P.O. Box 850, Pinedale, WY 82941

Several full-field developments, coupled with a USDI Bureau of Land Management (BLM) Field Office area with moderate to high potential for gas development in an area which maintains a world-class wildlife resource, has prompted the need for landscape scale

planning. In-fill development within the Jonah Field has led to companies providing compensatory mitigation funds in order to mitigate for impacts within the field that could not be avoided. Added development should necessitate the need for a landscape scale mitigation plan to identify how development should occur within the Upper Green River Basin; and how wildlife issues and mitigation funds should be utilized in order to address impacts and maintain wildlife resources. Development within SW Wyoming has prompted additional planning in the form of a SW Wyoming Landscape Initiative designed to examine these issues in a larger context. This paper will discuss mitigation needs on a landscape scale, as well as provide an update on a newly formed interagency office, was formed to address mitigation needs in relation to the associated development, primarily as it relates to those issues and species impacted in the Jonah Field. Finally, some discussion focused on planning needs that were not being addressed.

Wyoming Mitigation Concepts

Dan O. Stroud, Habitat Mitigation Biologist, Wildlife Division, Wyoming Game and Fish Department, P.O. Box 850, Pinedale, WY 82941

Energy has and continues to be one of Wyoming's primary economic engines; now perhaps more than ever. Currently, major development areas cover approximately 25 percent of the land area in the state. Within these areas, there are approximately 44,000 active wells, out of the 59,000 statewide. Some of these areas are currently going through the permitting process to greatly increase the amount of natural gas development. This increased development could easily be sustained over the next 30 years. Since most of this development also overlaps important wildlife habitats, it has forced the Wyoming Game and Fish Department to become proactive in dealing with these impacts and new approaches to mitigation. Some of these include 1) Working proactively with industry on individual plans to minimize and mitigate fish and wildlife impacts, 2) Working collaboratively with the BLM on the development plans, and on their Resource Management Plans to provide for greater consideration for wildlife, 3) Supporting the addition of a new office (Jonah Interagency Office) funded by industry, which will oversee and guide off-site mitigation, 4) Support for the hiring of an oil and gas coordinator in Pinedale, WY with funding provided by BLM and USFS, 5) Funding an Oil and Gas Coordinator Position in NE Wyoming, and 6) Working with our agency staff in terms of Department organization to shift personnel duties to address the issues associated with development. While all of these efforts have been somewhat effective, there is still a need for additional personnel time to address the expanding issues.

A Review of Energy Development in Montana; the How, What and Why

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Energy development may result in significant changes to Montana's landscape, especially on the plains of eastern and central Montana. This has resulted in questions as to the impact of these energy related activities on Montana's wildlife resources. To answer this question, we must first understand how much activity is currently permitted, what stipulations are attached to leases and how are Best Management Practices applied. In addition, through the Energy Act of 2005, pilot offices were established including one office in Montana (Miles City). What does it all mean?

A Synopsis of the Draft Supplemental Environmental Impact Statement Related to Coal Bed Natural Gas Development

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The Draft Supplemental Environmental Impact Statement (SEIS) is scheduled for release on 2 February 2007. As a result, thousands of federal wells have the potential to be drilled in the Powder River Basin of Montana. This presentation will address the anticipated level of development, management practices to be implemented and alternatives being considered. Information on submitting comments were presented.

Greater Sage Grouse Population Response to Energy Development and Habitat Loss

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Modification of landscapes by energy development may alter both habitat use and vital rates of sensitive wildlife species. Greater sage grouse (*Centrocercus urophasianus*) in the Powder River Basin (PRB) of Wyoming and Montana are experiencing widespread, rapid changes to habitat due to recent coal-bed natural gas (CBNG) development. We analyzed lek-count, habitat, and infrastructure data to test how CBNG development and other landscape features influenced sage-grouse population trends and lek status in the PRB. From 2000-2005 leks in CBNG fields showed lower trends in population indices and 11-55 percent fewer males per active lek than leks outside CBNG development. Among lek complexes of known status in 2004-2005, only 34 percent remained active within CBNG fields, compared to 82-83 percent of leks adjacent to or outside CBNG, and all remaining large and medium-sized leks (¡Ý 25 males) occurred outside CBNG. Lek-complex persistence was positively influenced by the proportion of sagebrush habitat and negatively influenced by the proportion of tillage agriculture at large scales around leks. After controlling for habitat loss, lek-complex persistence was also negatively influenced by the extent of CBNG development at all scales, with the strongest effects occurring within 0.8 km. Maintaining sage grouse populations in areas with CBNG likely will be difficult without a major shift in mitigation strategies toward spatial, rather than temporal restrictions on development, and rapid implementation of enhanced industry-wide standards for mitigation. Our findings also emphasized a need for government agencies to set population goals for conservation and conduct landscape-scale conservation planning for sensitive wildlife species prior to energy development.

Highlights from 15 Years of White-Tailed Deer Research in Northwestern Montana

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White-tailed deer (*Odocoileus virginianus*) are the most abundant big game species in northwest Montana, accounting for more than 75 percent of annual deer harvests in Montana Fish, Wildlife and Parks' (FWP) Region 1. FWP initiated a study in 1988 in the Salish Mountains to better define ecological relationships of white-tailed deer occupying conifer-dominated winter ranges in northwest Montana. Data collection spanned the period of 1988-2000; however, collection of harvest records continued through 2003. Most white-tailed deer in the Salish Mountains typically migrated ~20-30 km (12-19 mi) between summer ranges consisting of higher elevation forest and meadows and winter ranges in lower valleys with relatively dense coniferous cover. Patterns of resource use supported a hypothesis that deer enhance survival by adopting a strategy of energy conservation during most winters. Dense tree canopy intercepts snowfall and hence reduces energetic costs of movement and likely enhances ability to evade predators. Overall deer density in the Salish Mountains ranged from 2.3-10.8 deer/km^2 (6-28 deer/mi^2) with densities on winter range from 130-205 deer/km^2 (116-530/mi^2). We conclude that variation in female survival operated independently of recruitment to drive population trend of white-tailed deer in the Salish Mountains. More detailed results of this work are available in the recently completed report titled: White-tailed Deer Studies in the Salish Mountains, Northwest Montana, published by FWP.

Large-Scale Genetic Structure of Black-Backed Woodpeckers

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The black-backed woodpecker is a naturally rare, wide-ranging woodpecker that inhabits recently burned forests. Due to their natural rarity, little is known regarding black-backed woodpecker movement patterns and population structure. Genetic techniques allow us to measure population structure without intensive fieldwork, such as mark-resight methods. In general, avian populations show little genetic differentiation due to high rates of dispersal, often over exceedingly large distances. This fact, combined with the ephemeral nature of black-backed woodpecker habitat, has led us to predict that black-backed woodpeckers would have little genetic differentiation, even at large geographic scales. In contrast, we have found substantial genetic differentiation along an east/west gradient for birds sampled in Oregon, Idaho, Montana, South Dakota, and Alberta for mitochondrial DNA. However, there was little evidence of genetic differentiation along a north/south gradient within the Rocky Mountains. We detected three main groups of populations: West (Oregon), Mid (Idaho, Montana, and

Alberta), and East (South Dakota). We are currently examining nuclear loci, which will be used in combination with our current mtDNA results, to determine if these groups should be managed as distinct population segments or separate management areas.

Patterns and Rates of Wolverine Movement Using GPS Technology in Glacier National Park, Montana

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Documentation of wolverine presence in remote areas has been carried out using winter track surveys. Description of wolverine travel patterns and rates of travel have been based on anecdotal evidence at best. During the past 4 yrs we captured and instrumented 22 wolverines in Glacier National Park. Of these, five individuals have successfully carried Lotek store-on-board GPS collars for periods of up to several months, and have provided nearly 10,000 data points. A high recapture rate provided an opportunity to reinstrument individuals with varying GPS acquisition rates within a single trapping season. Initial GPS location data were programmed for a 4-hr cadence, but wolverine movement rates at this interval did not provide adequate information on travel paths and patterns and indicated a need for a finer scale fix rate. We varied the frequency of GPS fix attempts at 4 hours, 2 hours, 30 min, and 5 min as we recaptured study animals. Subsequently most data sets were programmed to collect GPS locations at 5-min intervals, 24 hrs/day, 7 days/wk. Analysis of these fine-scale data reveals travel paths and corridors, as well as rates and patterns of travel for wolverines astride the Continental Divide in alpine and subalpine sections of Glacier National Park.