Abstracts

Biological Sciences - Terrestrial

Is This Really Happening? Old Growth in DNRC[TWS]

Jane Adams
Private Citizen, Kalispell, MT 59901

Jane Adams describes her experience as a "whistle blower" while working as a wildlife biologist for the DNRC. She tells the story of a large timber sale in the Swan Valley in which DNRC planned to harvest over 600 ac of high-quality old growth, yet the EIS didn't even mention that old growth would be harvested. The EIS instead analyzed "old stands", defined as stands at least 150 years old with 4 MMBF per acre, regardless of forest type. This definition is met by 6 large trees per acre. Such stands provide little to no habitat for old-growth associated wildlife species and few of the ecological characteristics of old growth. However, using this definition allowed DNRC to harvest most of the trees from virgin old growth stands, and claim that the number of acres of old stands would not changed. DNRC also claimed they only needed to maintain 13 percent of the Swan River State Forest as old growth, despite the fact that about 74 percent of it was old growth historically, and they have publicly committed to maintain at least 50 percent of historic old growth. Jane refused to support the analysis in this EIS, and management made working conditions so intolerable she felt forced to quit.

Montana-wide Burrowing Owl Surveys; A Synthesis of First Year Efforts—1999[TWS]

Eric C. Atkinson
Marmot's Edge Conservation, 4580 E. Baseline Rd., Belgrade, MT 59714

Dennis L. Flath
Nongame Program, Montana Fish, Wildlife & Parks, P.O. Box 173220, Bozeman, MT 59717

Population trend information, as well as present dispersion and abundance measures, are sorely lacking for burrowing owls (*Athene cunicularia*) inhabiting Montana. To develop baseline information that can lead to assessments of population trends, we invoked a cooperative network of 28 surveyors to sample black-tailed prairie dog (*Cynomys ludovicianus*) colonies across the state. Prairie dog towns were randomly selected, stratified by quarter latilong (0.5° x 0.5°) from the 1,302 prairie dog towns contained in the statewide database archived by the Montana Natural Heritage Program. Three hundred, seventeen towns were selected for survey based upon a proportional sampling regime. Area-based surveys were

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[MAS] *Montana Academy of Sciences Annual Meeting, Missoula, MT, April 28-29, 2000*
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performed between 15 July-8 August. We surveyed 209 colonies (204 with usable data; 10,079 ac; 4081 ha) observing 474 burrowing owls and a minimum of 123 burrowing owl pairs. Seventy eight colonies were occupied by owls (38.24%) with average number of owls per town equaling 2.33 (SD = 4.23), with most supporting one pair (X = 0.61 + 1.00 pair, n = 204). Based upon the these data, we estimate that Montana prairie dog colonies supported between 787 and 819 burrowing owl pairs in 1999. Plans for 2000 include defining 'bellweather' colonies for longterm trend monitoring through sampling with partial replacement and expanding the network of cooperators.

The Effects of Groomed Roads on the Behavior and Distribution of Bison in Yellowstone National Park[TWS]

Daniel D. Bjornlie and Robert A. Garrott
Fish and Wildlife Management Program, Biology Department,
Montana State University, Bozeman, MT 59717

The road grooming needed to support snowmobile travel in Yellowstone National Park has come under examination for its effects on bison (*Bison bison*) ecology. Data were collected from November 1997 through May 1998 and again from December 1998 through May 1999 on the effects of road grooming on bison in Madison-Gibbon-Firehole area of Yellowstone National Park. The study area roads were surveyed by crewmembers for use by bison. The trend for both seasons showed moderate numbers of groups traveling on roads in late fall/early winter, prior to road grooming. Road use leveled off in midwinter before peaking sharply in April. This sharp increase coincided with the beginning of spring melt at lower elevations of the study area and occurred after road grooming had ceased. Bison surveys of the entire study area were conducted over both field seasons. These surveys provided data on bison locations and behavior from over 28,000 bison observations. During the road-grooming period, 18 percent of observed bison travel took place on groomed roads. Most travel (57 %) took place off of roads and established trails. For December through March, travel accounted for only 0.7 percent of observed snow-displacing bison behavior, while foraging accounted for 42.5 percent. Bison appeared to utilize corridors such as waterways for off-road travel pathways. Location data, along with data from infrared trail monitors, were utilized to assess the aspects of off-road movements. These data indicate that the Mary Mountain trail between the Hayden Valley and the Firehole continued to be the major route for bison winter distributional shifts.

Habitat Relationships of Sympatric Moose and Elk in the Garnet Mountains of Western Montana[TWS]

Milo Burcham and C. Les Marcum
University of Montana, Missoula, MT 59812

A low-density moose population in the Garnet Mountains of western Montana is being studied to evaluate the effects of managing forest habitats for elk. From 1993-1996, over 2800 locations from 69 elk were collected and analyzed to evaluate the long-term effects of timber harvest on habitat use, home ranges, and distribution

of elk as part of the Chamberlain Creek Elk Studies. This has provided an opportunity to evaluate a sympatric moose population, of interest to local land managers. Since January 1998, > 700 locations of 18 radio-collared moose have been obtained to evaluate moose habitat preferences as well as habitat use overlap with elk, and the potential influence of implementing elk management guidelines on this moose population. Additionally, in early January 2000 we counted 44 moose during a helicopter census of moose in the study area. Preliminary results at the end of 2 years of field work were described.

Species Occurrence and Distribution of Bats in North Central Montana: Range Map Changes Resulting From Two Years of Field Surveys[TWS]

Kristi DuBois
Montana Fish, Wildlife and Parks,
4600 Giant Springs Road, Great Falls, MT 59405

Bat surveys were conducted in north central Montana, as part of vertebrate species inventories of FWP wildlife management areas in 1998 and 1999. As a group, bats are poorly known in Montana. The most basic biological information on bats (species occurrence, distribution, habitat use) has not been collected in north central Montana. Knowledge of the occurrence and distribution of bats would enable conservation efforts to be initiated, if needed, to protect declining species. Occurrence records obtained from the Montana Natural Heritage Program in early 1998 included only 26 records from FWP Region 4. Most were museum specimens collected prior to 1970. The purpose of this study was to evaluate Region 4 Wildlife Management Areas and other FWP properties for potential bat use and contribute to knowledge of the species occurrence and distribution of bats in Montana. We captured over 250 bats using mist-nets, identified them to species, and determined forearm length, sex, age, weight, and reproductive status when possible. We documented large range extensions for the fringed myotis (*Myotis thysanodes*), which is a Species of Special Concern and dramatically increased the known occurrances of several other species. Information for some species indicate recent population declines, but for other species we may simply lack information to determine population status. Additional surveys of bats in Montana are needed to fill in these information gaps and get conservation efforts directed where needed most. Conservation actions to reverse population declines are most effective when taken before populations drop to the critical levels that lead to endangered species listing.

Stories from A Wildlife Advocate[TWS]

Janet Ellis
Executive Director, Montana Audubon, Helena, MT 59601

Being an advocate can affect you professionally, as well as personally. Carefully planning when and how to act is important. As a wildlife advocate for twenty years, I will talk about some of the personal experiences I've faced - and some of the lessons learned.

Snow And Climate Data In Wildlife Studies[TWS]

Phillip E. Farnes, Carolyn L. Heydon, and Katherine J. Hansen
Department of Earth Sciences, Montana State University,
Bozeman, MT 59717

Implementation of the snow survey telemetry (SNOTEL) system in the mountainous areas of the west by the Natural Resources and Conservation Service (NRCS) has provided near real-time daily climatic data year-around from areas typically inhabited by wildlife. Parameters measured typically include maximum, minimum, and average air temperatures, precipitation and snow water equivalent. When combined with National Weather Service Climatological Station data at lower elevation valley locations, a profile of climatic data can be extrapolated to most areas and elevations. The availability of daily data also makes it possible to calculate soil moisture and growing degree-days to estimate forage production on summer, transition, and winter ranges and to calculate index of winter severity for different species for various areas. Migration from summer to winter ranges can be related to snow water equivalent. Time of snowmelt and spring green-up can be related to temperature. In addition, analysis of critical climatic data parameters can be used to estimate whitebark pine cone and huckleberry production critical to grizzly bear survival. These data can also be used to estimate winter mortality, reproduction, predation, and physical condition of ungulates going into the winter. These are just a few examples of how climate and wildlife interact. Procedures to develop useable climatic data and algorithms used to develop independent parameters were presented and discussed. Examples of how these data might be used in wildlife management also were discussed.

A Black-tailed Prairie Dog Conservation Strategy for Montana[TWS]

Dennis L. Flath
Nongame Program, Montana Fish, Wildlife and Parks,
P.O. Box 173220, Bozeman, MT 59717

Evolution of black-tailed prairie dog (*Cynomys ludovicianus*) conservation in Montana is documented, including initial efforts, development of management guidelines, establishment and composition of a working group, response to the petition to list the species, drafting of a Montana conservation strategy, and relationships between Montana's efforts and those of other states. Updated information on the current status of Montana's black-tailed prairie dog population is presented. Montana's conservation efforts predate those of other states, resulting in a unique leadership role in regional conservation planning. Details of the Montana Conservation Plan are discussed, including the goal of providing for management of prairie dog populations and habitats to ensure long-term viability of prairie dogs and associated species. Five objectives and associated strategies deemed necessary to achieve this goal are described. The relationship between state planning and conservation efforts and potential federal classification is discussed as well as updated information on the status of the listing petition.

Twenty-three Years of Raptor Trend Data for Montana[TWS]

Dennis L. Flath and Ryan L. Rausher
Montana Fish, Wildlife and Parks, P.O. Box 173220,
Bozeman, MT 59717

A state-wide system of raptor survey routes was established in 1977 to develop long-term trend data on diurnal raptors. One route is located in each of the states 47 latilongs (degree blocks), and routes average 50 miles long. Routes are run by cooperators during nesting season annually from May 15-June 5. Number of birds seen per 1000 miles of route are calculated by species. Three year running means are presented to reduce effect of uncontrollable variables, and a regression is calculated to illustrate species' trends over the course of the survey effort. Population increases and decreases are reported for species for which this technique is adequate, and an example is provided for a species which cannot be monitored with this technique. Comparisons are made with Breeding Bird Survey data as well as other studies which corroborate and validate this technique. Since use of extensive transect data is not equally valid for all species, cautions are provided.

Environmental Variation and Demography of A Yellowstone Elk Population[TWS]

Robert A. Garrott, L. Lee Eberhardt, and Patrick J. White
Fish and Wildlife Management Program, Montana State University,
310 Lewis Hall, Bozeman, MT 59717

We conducted an intensive 7-year radio-telemetry study (1991-1998) of variations in vital rates of a nonmigratory population of elk in the upper Madison River drainage of Yellowstone National Park, Wyoming. Adult survival rates derived from 185 animal years of monitoring documented consistently high annual survival rates for animals 1-11 years of age (0.97), a pronounced onset of senescence beginning at age 12, and no animals surviving beyond age 15. The major cause of mortality was starvation in senescent animals with logistic regression indicating poorer survival in years with higher winter snowpack. Using fecal progestagen concentrations, we estimated late gestation pregnancy rates ranging from 0.83 to 0.96 annually. Logistic regression detected no significant annual differences in pregnancy rates (n=137 animal years) with a rate of 0.92 estimated for animals ≥2 years. A comparison of simulation-based parturition calf-cow ratio estimates and calf-cow ratios observed at the onset of winter suggested that 40-50 percent of the calves born each year were lost during the first 6 months of life. Overwinter calf survival, as indexed by changes in calf-cow ratios, was highly variable, with regression models revealing a strong correlation between annual variation in winter snowpack and calf recruitment. All documented overwinter calf mortality was attributed to starvation with the most severe winter conditions resulting in the virtual elimination of the juvenile cohort. Data collected in the study were synthesized into a population projection model by combining stochastic Monte Carlo simulations and the bootstrapping technique and suggested a considerable degree of stability in the system, in spite of substantial variability in final population sizes.

Professional Ethics and Resource Management in the National Park Service[TWS]

Steve Gniadek
Glacier National Park, West Glacier, MT 59936

The credibility of our profession depends on how we as wildlife biologists respond to the ethical challenges confronting us. Institutional tendencies, human nature, and political pressures exert an increasingly powerful influence on our daily activities. This may result in the transfer of information favorable to the leaders and culture of an organization rather than to the resource. Yet our ethical standards for professional conduct dictate avoidance of activities "detrimental to the well-being of the wildlife resource and its environment." This dilemma is compounded in the National Park Service, an agency that has yet to live up to its mandated role in environmental leadership and resource protection. Contemporary examples of ethical challenges will be presented in the context of the history and traditions of that agency.

Fetal Development and Timing of Births of Yellowstone National Park Bison[TWS]

Peter J. P. Gogan and
United States Geological Survey, Northern Rocky Mountain Science Center, Montana State University, Bozeman, MT 59717

Kevin M. Podruzny
Department of Biology, Montana State University, Bozeman, MT 59717

Edward M. Olexa
Northern Rocky Mountain Science Center, Montana State University, Bozeman, MT 59717

Helga Ihsle Pac and Kevin L. Frey
Montana Fish, Wildlife and Parks
Box 173220, Bozeman, MT 59717

Historical and contemporary reductions in Yellowstone National Park (YNP) bison (*Bison bison*) allowed us to describe changes in fetal development and timing of births over years and by herd. Fetuses were collected from 244 bison cows that were killed in various management actions (20 January-6 February 1941, $n = 74$; 16 January-1 April 1989, $n = 49$; 20 November 1996-6 March 1997, $n = 88$; and 8 January-15 April 1999, $n = 33$). We recorded collection date, herd, and weight (g) for each fetus. Assuming mean gestation length at 281 days and mean birth weight at 25,000 g, we estimated calving dates. Fetal weights varied from 64 to 27,000 g. Subsequent fetal ages were estimated at 96 to 286 days. Median predicted birth dates varied from late April in 1941 and 1989 to early May in 1997 and 1999. Median predicted birth date in 1941 was approximately 11 days earlier than contemporary estimates. Contemporary birth date estimates were approximately 1 week earlier for the Northern Range (NR) herd than the Central herd. Median predicted birth dates were

consistent with previously reported peaks, calf-to-adult ratio estimates of peak calving, and births of captive YNP bison calves. However, estimated births were highly skewed, with calves appearing up to 17 weeks beyond the herd peaks. For the NR and Central herds, 90 percent of births would have occurred by late May, 95 percent by mid to late June, and 99 percent by late July to late August. Knowledge of birth dates could allow managers to reduce the risk of contact with cattle during critical periods when brucellosis is suspected to be transmittable.

Development of Aerial Survey Methodology for Bison Population Estimation in Yellowstone National Park[TWS]

Steven C. Hess and Robert A. Garrott
Fish and Wildlife Management Program, Biology Department,
Montana State University, Bozeman, MT 59717

L. Lee Eberhardt
Adjunct Affiliate, Fish and Wildlife Management Program,
Biology Department, Montana State University, Bozeman, MT 59717.

Aerial survey methods for statistically rigorous bison population estimation are being developed for Yellowstone National Park (YNP) to support sound resource management decisions and to understand bison ecology. This survey methodology quantifies a sampling universe and sampling units, standardizes search effort, and employs a stratified sampling design, which accounts for undetected animals. Including seasonally occupied areas outside YNP boundaries, 76 survey units with area of 2,339 km^2 comprise the entirety of our designated survey extent, roughly equivalent to 26 percent of the area of YNP. The same survey units and total extent are used both in winter and in summer, but survey units have different strata designations for each season. During winter, 52 percent of the entire survey area is designated to be in the high density stratum, although in summer, 41 percent of this area is in the high density stratum. Concurrent intensive ground surveys, or 'double sampling', in the Madison-Gibbon-Firehole areas and the Northern Range in winter were used to estimate the magnitude and variability in detectability during specific aerial surveys. In comparing these simultaneous ground and aerial surveys primarily in winter, only 84.3 percent of the groups were detected on average from aircraft, although 94.8 percent of individual bison were detected. During the summer breeding period, as much as 70 percent of the entire bison population is aggregated in significantly larger, highly visible groups in Hayden Valley than observed during winter. Low variability between counts and high detectability suggest that precise and unbiased population estimates should be readily obtainable.

Effectiveness of Covered Track Plates for Detecting American Marten[TWS]

Jacob S. Ivan
Wildlife Biology Program, The University of Montana, Missoula, MT 59812

Kerry R. Foresman
Division of Biological Sciences, The University of Montana, Missoula, MT 59812

I assessed the effectiveness of covered track plates for detecting American marten in western Montana by 1) estimating the probability of detecting marten when they are present on a survey unit (POD_{su}), 2) estimating the probability of detecting a particular individual that resides on a survey unit (POD_{ind}), and 3) assessing the behavior of marten near track plates. Additionally I tested the validity of deriving POD_{su} from latency to detection (LTD). I radio-collared and branded the toe pads of 1-2 marten on each of 10 10.44-km^2 survey units. I located marten daily during 12-day survey periods. Concurrently, I deployed track plates as per the USFS protocol. Additionally, I monitored a subset of track plates with modified telemetry systems (MTS) that logged the presence of marten near plates. Radio locations indicated that all collared marten were present on their respective survey units and should have been detected by plates. POD_{su} was fairly high (POD = 0.70, n = 10, 95% CI: 0.42 – 0.98), but POD_{ind} was quite low (POD_{ind} = 0.067 – 0.133, n = 15, 95% CI: 0.00 – 0.31). MTS data indicated that 2 of 8 marten approached track plates, but never entered. POD_{su} derived empirically was lower than that derived from LTD. Track plates seem to work acceptably well in areas where marten densities are relatively high. However, low POD_{ind} indicates they may not work as reliably in areas with low marten density. More research is required to determine how POD varies with marten density, home range, behavior, and environmental variables.

Hunting and Fishing Rights, Treaties, Court Cases, the Tangled Web of History, or the Politics of Resource Regulation[TWS]

Jerry Kaiser
Bureau of Indian Affairs, Billings, MT 59101

One underlying purpose of Indian treaties was to enable the Indians to sustain themselves to maintain their livelihood on the reservations. Some treaties expressly guaranteed that Indians could continue certain subsistence activities (including hunting and fishing primarily, but also gathering, cutting timber and grazing livestock) outside the boundaries of their reservations in common with non-Indian citizens. All treaties expressly or implicitly reserved an exclusive right for tribes to carry out subsistence activities inside their reservations. These guarantees are generally known as "reserved rights." Courts have spent almost a century grappling with these subsistence rights themselves, governmental jurisdiction over such rights, and Congress' intentions towards them.

Selective Use of Black-tailed Prairie Dog Colonies by Mountain Plovers—A Second Look[TWS]

Craig J. Knowles
FaunaWest Wildlife Consultants, POB 113, Boulder, MT 59623.

A study conducted by Knowles et al. (1982) in 1979 documenting the selective use of black-tailed prairie dog (*Cynomys ludovicianus*) colonies by mountain plovers (*Charadrius montanus*) on the Charles M. Russell National Wildlife Refuge (CMR) in north-central Montana was repeated in July 1999. During the 20 year interval between plover surveys, prairie dog acreage in the survey portion of the CMR declined from 908 ha to about 200 ha in 1999 due to an apparent epizootic of sylvatic plague from 1992 to 1996. The 1979 survey recorded an average of 9.1 mountain plovers per survey run with 99 percent of these observations being recorded on prairie dog colonies. The 1999 survey recorded an average of 0.5 mountain plovers per survey run along the identical survey route. All 3 mountain plovers were observed on 1 of the few non-plague impacted prairie dog colonies remaining in this area. Within the survey portion of the CMR, prairie dogs are necessary to provide suitable habitat for mountain plovers. Prairie dogs reduce vegetation height, total plant cover and plant litter, and increase the amount of bare ground. Large, closely spaced prairie dog colonies are probably important for the long-term persistence of mountain plovers on the glaciated plains in north-central Montana.

Electricity in Wildlife Management; the Shocking Truth![TWS]

Randy Machett
U.S. Fish and Wildlife Service, Box 110, Lewistown, MT 59457

Mike Madel
Montana Fish Wildlife and Parks, Choteau, MT 59422

Diane Boyd and Frank Durbian
U.S. Fish and Wildlife Service, Helena, MT 59601

Behavior, movements, and survival of several wildlife species have been successfully managed with electrified fences. Electric fences have protected endangered black-footed ferrets (*Mustela nigripes*) from predation by excluding coyotes (*Canis latrans*) and badgers (*Taxidea taxus*) from >1,000 acre black-tailed prairie dog complexes for months in Montana and South Dakota. Several large carnivore species have been successfully excluded from human conflict sites along Montana's Rocky Mountain East Front with a variety of electrically charged wires and configurations. Wolves (*Canis lupus*) have been temporarily contained at release sites inside electrified enclosures to increase establishment success in Arizona and Montana. Wildlife management with electric fences is not a panacea but has been useful in a variety of situations. This presentation reviews our successes and the limitations of these techniques so that others may learn from our experiences with electric fencing in wildlife management.

Canyon Wren Observations in Sanders County Montana During 1999[TWS]

Gene Miller
Montana Fish, Wildlife & Parks, P.O. Box 1376, Thompson Falls, MT 59873.

Canyon wrens (*Catherpes mexicanus*) have been observed between Weeksville Creek and Munsen Creek, approximately 100 miles northwest of Missoula, during the last 15 years on this northern edge of their known range. Since there is little information on canyon wrens for this area, an effort to gain basic information (local distribution, density, nesting phenology, seasonal occurrence, territory components) was initiated on 20 February. Surveys were conducted along cliff/talus habitat north of the Clark Fork River for approximately 5 miles. Sixty-eight sites were surveyed using playback of recorded canyon wren songs, resulting in observed responses at 16 sites and a total of 206 separate observations during a 12-month period. Canyon wrens were observed in this area during each month. Pairs, nests, first-nest fledglings, and second-nest fledglings were found at 6, 2, 6, and 4 sites, respectively. Fledglings were first found on 6 June at the base of talus in 3 territories. Second nests were found on 27 June with young leaving the nest on 11 July. Four fledglings were found at 1 territory. Territories where fledglings were found ranged in size from 10,000 to 49,000 m^2 (talus 6,000-38,000 m^2/cliff 3,000-11,000 m^2). Other territory components include elevation (742-1036 m), slope (30-40°), aspect (170-210°), and mean size of rock at talus base (62-115 cm) and mid-elevation talus (14-46 cm). This observational study has contributed to the limited knowledge for canyon wrens, has documented that they can nest twice each season this far north, and that they are yearlong residents near the northern limit of their range.

Multi-scale Analysis of Fire-killed Dead for Management of Woodpeckers[TWS]

Tricia O'Conner
Lolo National Forest, Plains/Thompson Falls Ranger District,
P.O. Box 429, Plains, MT 59859

Mike Hillis
Lolo National Forest, Building 24, Fort Missoula, Missoula, MT 59804

Fire-killed dead is an important landscape component as well as critical habitat for many wildlife species. Salvage sales are common on National Forest lands after wildfires and result in loss of habitat for many species, including woodpeckers. Limited information is available to help design salvage sales to maintain adequate habitat for these woodpeckers. We propose a multi-scale analysis of this important habitat. This analysis was done for wildfires that occurred in 1998 on the Lolo National Forest in western Montana, which resulted in the decision to salvage within only one fire. Within this fire, we assumed that all stands of fire-killed dead were of equal value to woodpeckers, regardless of patch size or location and a portion of the fire-killed dead was proposed for logging. To test this assumption, we inventoried the fire in 1999 and located 29 woodpecker nests within the 600 ha of stand replacement fire. Results indicate that within the stand replacement burn,

burn intensity, patch size and patch location may be important indicators of the relative value of patches for several woodpecker species. This information can be used to help plan future salvage sales.

Assessing Patterns of Urban Development to Predict Future Habitat Availability and Species Diversity[TWS]

Lauren Oechsli, Jay Rotella, and Andy Hansen
Department of Biology, Montana State University, Bozeman, MT 59717

The western portion of the United States is the fastest growing region in the country in both population and per capita income. With growth and increased wealth come development and the conversion of lands from natural habitats to urban and rural residential landscapes. Loss and alteration of habitat directly affect members of biotic communities. As habitat loss is the leading cause of species' extinction and endangerment, it is wise to assess habitat availabilities and roles in biodiversity prior to extensive land change or fragmentation. This study employs a GIS and aerial photographs to determine the pattern of urbanization in the Gallatin Canyon/Big Sky planning district of Gallatin County, Montana. Analysis of building locations in reference to vegetation identifies those habitats most often chosen for development. Multivariate analysis is used to assess the correlation of abiotic and biotic variables with development. The results of this analysis are used to assess the similarity of all undeveloped areas to those that have been impacted by development. Species distribution models from the Montana GAP project are used to classify suitable/unsuitable habitat for all potential vertebrate species (excluding fishes) and assess biodiversity. 'Hot spots' of biodiversity are identified, and the environmental variables at those locations are compared to those in developed areas. The information generated by these analyses is useful to human communities wanting to make better-informed decisions regarding zoning plans and open-space preserves.

Ground –Based Radiometers, Real-time Gps Receivers, and Laser Rangefinders—New Techniques for Estimating Vegetation Parameters and Animal Use Sites[TWS]

Tom Olenicki
Department of Biology, Montana State University, Bozeman, MT 59717

Wildlife personnel have long desired methods to estimate live herbaceous biomass and utilization at a fine scale over large areas. New techniques incorporating ground-based radiometers and satellite imagery may provide methods for estimating biomass at different times during the growing season, thereby allowing utilization to be estimated by differences between estimates. Although these techniques are very promising, they are not without limitations. Preliminary results for biomass estimation in the Hayden Valley of Yellowstone National Park, the Sun River Game Range, and a portion of the Missouri Breaks area will be presented along with some of the limitations of this technique. The non-destructive methods of biomass estimation with ground-based radiometers are particularly suited for monitoring selected locations over time as long as they can be

precisely located. Real-time GPS can provide a far more accurate way to relocate monitoring sites than the averaging mode of commercially available GPS receivers or military PLGR's. Initial results indicate real-time GPS can relocate positions within 1m, making the combination of ground-based radiometers and real-time GPS ideal for monitoring temporal change. Although remote sensing techniques and real-time GPS can greatly increase our ability to accurately assess vegetation parameters, analysis of animal use sites is only as good as the positional accuracy of animal locations. A laser rangefinder and digital compass interfaced with a GPS receiver can provide positional accuracy of animal use sites consistent with the accuracy of sampling data. Although an accuracy assessment has not been completed, preliminary results indicate locations obtained at a distance in excess of 500 m with a laser rangefinder to be within 1m of the true location. In addition to providing more accurate locations for analysis, animal locations obtained with a laser rangefinder can subsequently be revisited using a real-time GPS receiver.

Hawk Shooting: Not Just A Problem of the Past[TWS]

Chad V. Olson
Montana Cooperative Wildlife Research Unit, University of Montana, Missoula, MT 59812

During the winters of 1997-1998 and 1998-1999, I investigated the causes, frequencies, and characteristics of human-related winter mortality of raptors in the Mission Valley, Montana, by systematically searching along roadside corridors for dead birds. Surveys included both primary and secondary roads, and most were paralleled by power lines. I found a total of 126 dead raptors during the two winters, including 58 in 1997-98, and 68 in 1998-99. Nine different species were found, but most were Rough-legged Hawks (*Buteo lagopus*) (49%) and Red-tailed Hawks (*Buteo jamaicensis*) (29%). Of 88 birds collected and examined, 74 (84 %) were shot, 8 (10%) were electrocuted, 4 (5%) the cause remained unknown, 1 (1%) died by collision, and 1 (1 percent) died from predation. Those not examined were either too scavenged or too decomposed for necropsy, but did not differ in location from those examined. Although 52 percent of dead birds were found directly beneath power poles or lines, and dead birds were found under a wide variety of pole configurations, very few were actually electrocuted. Furthermore, electrocuted birds were associated with only a few types of pole configurations, and most included jumper wires and/or transformers. As for characteristics, shot birds more often had shattered bones and bruising and/or hematomas and were characterized by shearing of flight feathers, sprayed or spattered blood, and bullet fragments within entrance wounds. Electrocuted birds always showed some evidence of burns, but many (44%) required magnification optics to verify singeing of feathers. Curled, deformed, or incinerated talons also occurred with many electrocutions (33%). So, although electrocution and car collision are well recognized as major causes of winter mortality of raptors, and continue to be major sources of raptor mortality around the world, in certain areas shooting may still be the leading cause of raptor mortality.

The Use of Fecal Corticosteron and Behavioral Observations to Evaluate Human Disturbances to Bighorn Sheep[TWS]

Kayhan Ostovar
2724 Arvin Road, Billings, MT 59102

This study investigated the impact of human activity in Yellowstone National Park through the use of non-invasive fecal corticosterone monitoring and behavioral observations. Intensive behavioral observations were used to determine rates of human related disturbances in four distinct ewe groups and rams. Results indicated that the prevalence of humans did not correlate with the rate of overt disturbances observed in bighorn sheep groups. Foot traffic was the activity least likely to cause overt disturbances, while helicopter traffic caused the greatest and most predictable disturbances. The yearly cycle of corticosterone in free ranging bighorn sheep was determined from the analysis of 348 fecal samples from collared and non-collared rams and ewes. No significant difference was found in radio collared and non-collared bighorn sheep. Results indicated that higher levels of fecal corticosterone corresponded with greater disturbance rates of bighorn sheep groups. Cold temperatures and depletion of forage quantity and quality did not cause detectable increases in environmental stress on bighorn sheep during winter months. Significant increases in the fecal corticosterone levels of both rams and ewes during spring, can best be explained by increases in social activity and the near term conditions of pregnant ewes. Significant differences were also found between mature rams and both ewes and younger males. If the accumulation of disturbances was high enough, populations could experience poor recruitment and higher rates of disease and mortality. The baseline information collected on levels of fecal corticosterone will allow further environmental impact assessments of bighorn sheep and other vertebrate species.

Advocacy and Research: Can Credibility Be Maintained?[TWS]

Daniel H. Pletscher
Wildlife Biology Program, School of Forestry, The University of Montana, Missoula, MT 59812

Research in wildlife biology frequently involves an investigation of the relationship between a human-caused perturbation and a vertebrate population; often, the perceived or actual relationship evokes strong emotional and/or economic consequences. A researcher who examines these relationships and is highly partisan generally has little credibility among the public due to real or perceived bias. Whether the bias is real or perceived makes little difference in terms of credibility. For example, a researcher from Safari Club International examining whether a rare ungulate population in Africa would benefit from a trophy hunting program would have credibility similar to a researcher from People for the Ethical Treatment of Animals with a large segment of the public. Most people would expect results from timber company researchers into the effects of timber harvesting on a wildlife species would be quite different than similar research conducted by wilderness advocates. Researchers using public funds are expected and trusted to produce reliable information that can be used in the decision-making process. Wildlife

researchers should strive to eliminate bias and maintain credibility. They should publish their results through the peer-review process *and* make their information available to the public through talks and the media.

Putting the Advocacy Tiger to Sleep— A Montana Case History[TWS]

Jim Posewitz
Orion The Hunter's Institute, Helena, MT 59601

Professional ethics and advocacy are timely topics to be addressed by this society. Ethics, as a subject, rarely penetrates the educational curriculums preparing natural scientists for professional lives. Advocacy, one a traditional role of fish and wildlife biologists, became a rare commodity within government as political favor replaced it as the currency of career advancement and leadership. Taken together, ethics and advocacy, pose a powerful question. Are there ethical responsibilities we have as fish and wildlife biologists to be advocates for fish, wildlife and the public interest in those resources? To address this question fish and wildlife professionals need to develop an awareness of our origin and the history of the resources placed in our professional custody. This presentation outlines how fish, wildlife, and portions of the public estate came into our contemporary custody. It also relates personal experiences of the author while in an agency transitioning from a strong fish and wildlife advocate to a politically responsive entity.

Tiger Salamander Axolotls in Blue Lake[TWS]

Ryan L. Rausher
Nongame Program, Montana Department of Fish, Wildlife and Parks,
1400 South 19th, Bozeman, MT 59717-3220

The axolotl is a life form of the tiger salamander (*Ambystoma tigrinum*), which retains larval characteristics as a sexually mature adult. This phenomenon, known as paedomorphosis, may be facultative (capable of metamorphosis) or obligate (incapable of metamorphosis). Although paedomorphosis occurs rather frequently in salamander breeding ponds, relatively few larva are actually paedomorphic in these ponds. Populations of salamanders where the majority of larvae are paedeomorphic are rare. The only known population of axolotls in southwestern Montana occurs in the Axolotl Lakes area in Madison County. Other axolotl populations may occur in other ponds or lakes with similar characteristics. This study sought to identify the type of paedomorphosis present in the Madison County population and develop a long-term conservation strategy. Axolotls were captured in June of 1998 and placed in a room temperature aquarium to determine if metamorphis would occur. All axolotls initiated metamorphosis within 48 days of placement in the aquarium. Diet may have played a role in initiating metamorphosis. Morphological measurements were taken on 204 individuals. Four size classes are apparent. Ages based on skeletal chronology varied from 0 to 12 years with apparent age gaps. Using a Lincoln/ Peterson population estimate, 5220 individuals occupied the lake in 1998. Three groups of axolotls captured in June, 1999 were exposed to three different water temperatures (Cold - 13 °C, Room - 21 °C,

Warm - 29 °C) to determine if metamorphosis was temperature dependent. Some paedomorphs metamorphosed from each tank. However, several paedomorhs in each tank failed to metamorphos well beyond 48 days suggesting a percentage of paedomophisis may be obligatory. Conservation should begin with protection of Blue Lake from fish introduction.

Prediction and Reality: Comparing Loggerhead Shrike Locations with Predicted Distribution Maps by Montana Gap Analysis[TWS]

R. L. Rauscher
Nongame Program, Montana Fish, Wildlife and Parks
1400 South 19th, Bozeman MT 59717

K. P. McLaughlin
Montana Cooperative Wildlife Research Unit, Wildlife Spatial Analysis Lab,
University of Montana, Missoula, MT 59812

Wildlife biologists and land managers often must make management recommendations with limited information and with limited distributional data for species such as the loggerhead shrike (*Lanius ludovicianus*). The Montana Gap Analysis Project (MT-GAP) may provide a tool to assist with such decisions. MT-GAP is a statewide assessment of biodiversity completed in 1998. For 425 species, ranges were delineated based on existing presence/absence data, and habitat associations were recorded in a wildlife-habitat relationships (WHR) database. After preparing GIS layers to represent specific habitat features, a raster-based modeling approach was used to combine range limits and WHR databases into predicted distributions. The loggerhead shrike model selected a number of shrub cover types, and also selected agricultural and grassland types where they fell within 500 m of the mesic shrub type. An elevation limit of 1950 m also was applied. Predicted habitat was 10,795,456 ha, or 28.35 percent of the state. An independent study recorded 101 locations of loggerhead shrikes statewide from 1997 to 1999. GIS analysis revealed that 44 point observations fell directly within the predicted distribution. To include the average home range size of loggerhead shrikes and to compensate for any locational inaccuracies, buffers then were applied to point observations, and overlap between buffers and predicted habitat was calculated. Sixty nine percent overlap was observed for 282 m home range buffers, and 80 percent for 500 m buffers. Despite the limitations of MT-GAP predicted distributions, they can be useful for broad-scale conservation planning, particularly for species with limited information.

Prevalence of Hantavirus in Montana—An Update[TWS]

Bill J. Semmens, Richard J. Douglass, and Amy J. Kuenzi
Biology Dept. Montana Tech., Butte, MT 59701

Susanne N. Zanto
Montana Dept. of Health and Environmental Sciences. Helena, MT 59620

The Polson, Wisdom, Gold Creek, Cascade, Cutbank, and CMR areas of Montana were surveyed for rodent density and presence of antibodies to hantavirus from June 1994 to October 1999. Surveys were made from May through October of each year except 1994, which was surveyed from June through October. We captured 7222 individual rodents, consisting of 18 species, within forest, grassland, sagebrush, and meadow habitats. Five of the 18 rodent species were confirmed to be positive for antibodies to hantavirus. Meadow voles (*Microtus pennsylvanicus*), boreal red-backed voles (*Clethrionomys gapperi*), sagebrush voles (*Lemmiscus curtatus*), and yellow-pine chipmunks (*Tamias amoenus*) made up a combined 5.4 percent of the infected rodents. We focused demographic analysis on deer mice (*Peromycus maniculatus*) which totaled 94.6 percent of the positive rodents. Infected deer mice were predominately males ($\chi^2 = 7.06$, 1df, $P = .0079$) and primarily adult males ($\chi^2 = 90.6$, 2 df, $P < 0.001$). Deer mice with scars had a greater infection rate than mice without scars ($\chi^2 = 67.4$, 1 df, $P < 0.0001$). Polson was shown to have the highest percent of infected deer mice of the 5 areas. Among habitats, sagebrush had the highest infection rates among deer mice. Higher infection rates among deer mice were found in May followed by July, June, August, September, and October.

Estimating Effective Population Size in Wild Populations for Conservation and Management[TWS]

Michael K. Schwartz
Wildlife Biology Program, University of Montana, Missoula MT 59812

Gordon Luikart
Laboratoire de Biologie des Populations d'Altitude, C RS UMR 5553,
Universite Joseph Fourier, Grenoble France

David A. Tallmon
Division of Biological Sciences, University of Montana, Missoula, MT 59812

Estimating abundance of wildlife has challenged managers for nearly a century. Relatively recently, wildlife biologists have been employing techniques used by molecular biologists to estimate an abundance parameter, called effective population size. Effective population size is the size of an ideal population that would have the same rate of genetic change as the population under consideration. Effective population size is approximately 10 percent of the census population size, and is an important parameter because it determines the rate of loss of genetic variation, fixation of deleterious alleles, and inbreeding. I will review three methods that take advantage of recent developments in D A sampling techniques and technology to estimate local, current, effective population size. The first technique is called gametic disequilibrium and requires approximately 90 samples from a

population to estimating effective population size. The second technique is called the heterozyote excess method, which again requires many samples from only one sampling occasion. Due to large sample size constraints, the gametic disequilibrium and heterozygote excess methods are more commonly used with anadromous fish and marine invertebrates. Lastly, the temporal allele method, which requires approximately 30 samples from two sampling occasions may be the most promising for estimating effective population size of endangered vertebrates. Recent advances in molecular genetics have also allowed researchers to "mark" animals by using individual genotypes obtained through either invasive, i.e., capturing animals and collecting ear punches or blood samples, or non-invasive, i.e., collection of scat and hairs, techniques. Combining DNA technology, which allows us to non-invasively mark elusive animals, with well-established capture-mark-recapture techniques provides promising ways to monitor endangered wildlife.

A Comparison of Non-invasive Sample Collection Techniques for Use in Genetic Analysis[TWS]

Jeff Stetz, Kris Peterson, Katherine Kendall, and Lisette Waits
West Glacier Field Station, West Glacier, MT 59936

No reliable information currently exists on the status of the grizzly bear (*Ursus arctos horribilis*) population within Glacier National Park (GNP) or for the Northern Continental Divide Ecosystem in northwest Montana. Recently developed genetic techniques allow us to determine the species, sex, and individual identity of bears using DNA extracted from hair and scat samples. We utilized two non-invasive sample techniques to study grizzly bear population status. Hair corrals were established in a systematic grid in the Greater Glacier area to estimate population density. To asses the power of sign surveys to monitor population trends, bear hair and scat were collected along trails in GNP. Different segments of the population appear to be sampled by the two methods. Only 16 percent of the 200 individual grizzly bears were identified in both sign surveys and hair traps. The female:male ratio of bears identified from hair trap samples was 1.2:1, whereas the ratio sampled in sign surveys was 1:3. To assist future project planning, we compare uses, biases, and costs of estimating population density using genetic techniques to those of traditional telemetry studies.

Evaluating Motorized-Access Impacts on Greater Yellowstone Grizzly Bear: A Population Slated for Delisting[MAS]

Keith D. Stockmann,
Predator Conservation Alliance, PO Box 6733, Bozeman, MT 59771

Several goals must be met for the US Fish and Wildlife Service (USFWS) to determine that the Yellowstone grizzly bear *(Ursus arctos horribilis)* population has recovered from its Endangered Species Act 'threatened species' status. These goals are broken down into both demographic and habitat objectives. Although some debate exists surrounding the attainment of demographic goals, the USFWS anticipates meeting these goals soon. On the other hand, the realization of habitat requirements for recovery seems unlikely. Recent literature demonstrates that

roads, motorized trails and snowmobile routes all pose serious threats to Yellowstone Ecosystem grizzly bear habitat. The US Forest Service (USFS) is the most extensive land manager in the Yellowstone Ecosystem. Predator Conservation field inventories reveal that USFS of motorized access are incomplete and inaccurate. As part of the Conservation Strategy, the USFWS is developing a scientifically defensible cumulative effects model to evaluate motorized impacts to grizzly bears. This model is needed to both declare recovery and manage the landscape after delisting. However, because the US Forest Service has yet to demonstrate that it can effectively inventory, monitor, and regulate motorized impacts to bear habitat crucial to the long term health of this grizzly population, the inputs for this model are not adequate to produce a reliable output. Due to this problem, I recommend not delisting this population of grizzly bears, until such time that the USFS significantly improve its ability to assess and control motorized impacts to grizzly bear habitat.

Documenting Grizzly Bear Movement Patterns with GPS Technology[TWS]

John Waller
Wildlife Biology Program, University of Montana, Missoula, MT 59812

Christopher Servheen
Grizzly Bear Recovery Program, US Fish and Wildlife Service,
Missoula, MT 59812

Grizzly bears *(Ursus arctos horribilis)* currently occur in only five isolated populations: the Yellowstone Ecosystem of Idaho, Montana, and Wyoming; the Northern Continental Divide Ecosystem (NCDE) of Montana; the Cabinet/Yaak Ecosystem of Montana; the Selkirks Ecosystem on northern Idaho; and the Northern Cascades Ecosystem of Washington. The extent of grizzly bear movement between these ecosystems is unknown, but may be nonexistent; no movement between ecosystems has been documented. Linkage between these populations is important to maintain genetic diversity within each population and to lesson the impacts of demographic and environmental stochasticity. Linear human development that occurs within or between grizzly bear habitats can fragment resident grizzly bear populations. Previous research concerning grizzly bear movements through human development corridors or use of "linkage zones" has been hampered by the difficulties inherent to radio telemetry in mountainous terrain. These difficulties include poor accuracy of ground telemetry and limited opportunity for aerial telemetry due to expense, weather conditions, and restriction to daylight hours. Recent advancements in GPS technology may allow us to overcome these difficulties, allowing accurate 24 hour tracking of grizzly bears. In 1998, we initiated a 3-year study of grizzly bear habitat and movement patterns along the US Highway 2 corridor in northwest Montana. This corridor lies between Glacier ational Park to the north, and the Bob Marshall Wilderness complex to the south. We captured nine grizzly bears within the corridor and subsequent aerial telemetry established that five of the nine were resident to the corridor and crossed US Highway 2 frequently. In 1999, we attempted to recapture these five individuals and fit them with GPS collars. We did not succeed in recapturing these five individuals, but three GPS collars were deployed on adult females not previously captured in the corridor.

One of the three collars did not function due to internal failure. However, the other two functioned admirably, collecting over 3200 locations over a 114 day period. Here I present some preliminary results from this state-of-the-art positioning system and our plans for continuing research.

Gallatin County Fish and Wildlife Habitat Assessment: A GIS Interface[TWS]

Bo Wilmer and Bob Garrott
Fish and Wildlife Management Program, Montana State University, Bozeman, MT 59717

Situated directly adjacent to Yellowstone National Park, Montana's Gallatin County provides a gateway to this unique ecosystem for both human recreationists as well as native wildlife. As such, expanding human land use has recently encroached upon historic migratory routes and important habitat for native species. Recognizing this conflict, Gallatin County has developed a comprehensive management plan for "smart growth" that allows for both continued economic development as well as effective conservation of native habitat. However, this plan lacked any inventory of habitat distributions across the County. Therefore, a team of graduate students at Montana State University (MSU-Bozeman) embarked on the first attempt to compile such an inventory. The resulting "Gallatin County Fish and Wildlife Habitat Assessment" represents not only a synthesis of the best available wildlife science, but it also provides for the first time a relevant context of reference data layers in a user-friendly GIS interface. This digital mapping tool allows planners to turn on map layers that are relevant to a particular planning decision. It is our hope that this product will contribute to the County's GIS initiative in a way that encompasses long-term habitat protection in concert with more immediate smart growth.

Final Report on Recreation and Wildlife Project[TWS]

Heidi Youmans and Gayle Joslin
Montana Fish, Wildlife, and Parks, Helena, MT 59620

The Montana Chapter of The Wildlife Society's Committee on Effects of Recreation on Rocky Mountain Wildlife completed a 3 year project to compile literature on this topic and assemble an on-line bibliography that can be accessed at www.montanatws.org. The Committee, comprised of about 45 active members, utilized approximately 1300 of the 4500 references in the bibliography to prepare a synthesis of literature entitled *Effects of Recreation on Rocky Mountain Wildlife: A Review for Montana.* The effects of recreation on various wildlife species groups, are addressed, including: amphibians and reptiles, small mammals, birds, semi-aquatic mammals, ungulates, carnivores, and the impacts of domestic dogs upon wildlife in the company of recreationists. In addition, the report provides a project overview, guide to the on-line bibliography, and four appendices including position statements, vertebrate species lists, project planning guidelines (MEPA checklists), and regulation and policy references. The project is on-going as efforts continue to build the annotated bibliography and provide on-line second editions to chapters of

the report. Printed copies of the report are available for $25 and are being widely distributed across North America and abroad. Approximately 100 individuals participated in this endeavor in some fashion. The project was supported through grants from fourteen entities.