Montana Chapter of the Wildlife Society

53nd Annual Meeting

Wildlife Disease: Challenges for Research & Management in the 21st Century

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Brent Lonner, President 2015-16
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Introduction

Wildlife disease management is arguably one of the greatest challenges of contemporary wildlife management. Wildlife disease has significant impacts not only on wildlife health and population status, but also with regard to human social and economic impacts. Additionally, zoonotic diseases have routinely played significant roles with respect to human health concerns for centuries. And alternatively, human and/or domestic livestock born pathogens can also have significant impacts on particular susceptible wildlife. Although occurrence of disease in wildlife can be a natural phenomenon, there appears to be increasing trends toward the appearance of novel or introduced diseases with severe consequences for wildlife populations. As is stated in a The Wildlife Society position statement from July, 2012:

> "Understanding transmission, pathophysiology, epidemiology, and ecology of pathogens and how they interact with wildlife hosts is essential for developing effective strategies to prevent or manage disease in wildlife. Better understanding of these concepts will enable wildlife managers and scientists to address disease challenges."

The 53rd annual meeting contained a total of 62 oral presentations, many of which focused on various aspects of local and national wildlife disease management and research. These presenters (wildlife managers, researchers, students, and others engaged in various forms of wildlife/habitat resource management) bettered our knowledge and understanding of how pathogens and disease events, large or small, impact living species at multiple levels. This year's banquet speaker was biologist and author Dr. Bruce Smith. Dr. Smith provided some valuable firsthand experience and perspectives related to working with diseases such as Brucellosis and Chronic Wasting Disease in the Greater Yellowstone Area. Just as important, Dr. Smith reminded us of the value of field biologists, wildlife managers and researchers having a working understanding of disease ecology along the way emphasizing the importance of good communication between wildlife professionals and the public on these topics

Hopefully the following presentation and poster abstracts will provide not only a better understanding of the importance and consequences of disease ecology and management, but wildlife research and management in general as we continue to progress into the 21st century.

Plenary Session Abstracts

In Order of Presenting Author
(* Denotes Presenter)

Hemorrhagic Disease in Montana

*Neil Anderson, Montana Fish, Wildlife and Parks, 1400 South 19th Ave., Bozeman, MT 59718
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Hemorrhagic Disease (HD) is caused by two groups of orbiviruses, bluetongue (BT) and epizootic hemorrhagic disease (EHD). Both BT and EHD are capable of causing large scale mortalities in white-tailed deer. Although both are capable of causing disease in other species, BT typically causes clinical symptoms and mortality in a larger range of species, including pronghorn and domestic sheep. Three subtypes of EHD and five subtypes of BT are known to exist in North America. Only EHD subtype 2 and BT subtype 17 have been identified in Montana. Both BT and EHD are transmitted by a biting midge and the onset of disease typically occurring in late summer/early fall with mortality cases decreasing rapidly after the first killing frost. HD was first documented in Montana in 1961. Montana Fish, Wildlife and Parks has participated in a national survey documenting HD occurrence since that time. Outbreaks within Montana appear to be becoming more frequent and the area affected has increased. Until 2013 HD had been limited to the east side of the Rocky Mountain front. However, in 2013 several counties in western Montana experience their first recorded EHD die-off in white-tailed deer. The history and potential future ramifications of HD outbreaks in MT are discussed.

An Overview of Some Emergent Infectious Diseases of Concern to Montana's Nongame Species

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Virulent infectious diseases in a variety of wildlife populations have increased over the past couple of decades in both natural and managed landscapes. Fungal and viral pathogens, aided by human disturbance of habitats and human, wildlife, and domestic animal derived transport, are playing an increasingly dominant role in wildlife disease epidemics. State and federal agencies and professional organizations such as this chapter need to do a better job of keeping wildlife professionals fully informed of all emerging infectious diseases in order to facilitate detection and a potential response at the earliest possible time. I will provide overviews of: 1) White-Nose Syndrome which is caused by a cold-adapted fungus that, since 2006, has killed more than 6 million bats in eastern North America and has continued to spread westward; 2) two chytrid fungi which have caused mass mortalities and extinctions of amphibians worldwide, including near extinction of the Northern Leopard Frog (Lithobates pipiens) and decline of the Western Toad (Anaxyrus boreas) in western Montana; 3) Tiger Salamander Ranavirus, an iridovirus which is the most likely cause of mass mortality events in larval Western Tiger Salamander (Ambystoma mavortium) populations that have been recorded across Montana; and 4) Snake Fungal Disease, which has emerged as a threat to some snake populations in eastern and midwestern North America since 2006 and may be spreading westward. In general, wildlife professionals in Montana should report observations of unhealthy wildlife and wildlife mortality events that may involve these and other emerging infectious diseases to the Montana Fish, Wildlife, and Parks Wildlife Laboratory in Bozeman in order to facilitate coordinated diagnoses and responses with other state and federal agencies.

A Historical Perspective of Bighorn Sheep Disease in Montana

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A historical overview of bighorn sheep disease in the state of Montana will be discussed by summarizing causes of morbidity and mortality experienced by various Montana bighorn herds. Changes in our understanding of bighorn sheep diseases, their impacts on herd health, and management strategies that may be directed at reducing risk of disease outbreaks in bighorn will be discussed. Additional information and updates on current health testing protocols and a multi-state effort to standardize testing protocols for bighorn sheep will also be presented.

Critters, Cooties and Congress: Managing Health at the Wildlife-Livestock Interface

*Lee C. Jones, U.S. Fish and Wildlife Service, Wildlife Health Office, 10 E. Babcock, Rm 105, Bozeman, MT 59715

Wildlife disease processes can be described as the interaction between the three principles of the epidemiologic triad model: host, agent and environment. Increasing human populations decrease the size and quality of the environment, and increase the complexity of the wildlife - domestic animal disease interface. Additional levels of complexity are added by regulatory, political and socioeconomic perspectives. Diseases such as brucellosis, hemorrhagic disease, avian influenza, malignant catarrhal fever and Mycoplasma bovis disease are making big headlines during an era of small budgets. The "One Health" concept challenges wildlife managers to think critically, think outside the boundaries and to actively integrate animal health into wildlife management at the landscape level.

Towards Proactive Wildlife Health – Global Insights on Conservation from the Wildlife Conservations Society's Wildlife Health & Health Policy Program

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The Wildlife Conservation Society's Wildlife Health & Health Policy Program, the first of its kind, evolved from the Field Veterinary Program begun in 1989. We work at the interface of wildlife health, domestic animal health, and human health and livelihoods, all as underpinned by the state of environmental stewardship. It is at this interface where the opportunities for infectious disease spread, environmental pollution and other disruptions to critical ecosystems are greatest, and where proactive approaches to ecosystem health can optimize benefits for all. Our program has grown to address important conservation issues impacting landscapes, seascapes and species around the world, including those related to Ebola virus disease, avian influenza, foot and mouth disease as it relates to cross-sectoral land-use planning, lead poisoning up food chains, canine distemper in Amur tigers, emerging zoonotic disease threats to human health, and policy-relevant quantification of relationships between environmental degradation and impacts on public health. As we try to work 'upstream' to address health-related challenges that limit conservation success, our toolbox includes research, training, education and outreach, the creation of enabling environments for addressing intersectoral conflicts, and sociopolitical engagement at a range of scales.

Presentation Abstracts

Alphabetical By First Authors Last Name
***Denotes Presenter**
****Denotes Student Presenter**

Social Living Mitigates the Costs of a Chronic Illness in a Cooperative Carnivore

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Andrew P. Dobson, Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ

Douglas W. Smith, Yellowstone Wolf Project, Yellowstone National Park, WY

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Infection risk is assumed to increase with social group size, and thus be a cost of group living. We assess infection risk and costs with respect to group size using data from an epidemic of sarcoptic mange (*Sarcoptes scabiei*) among gray wolves (*Canis lupus*). We demonstrate that group size does not predict infection risk and that large individual costs of infection, in terms of reduced survival, can be entirely offset by having sufficient numbers of pack-mates. Infected individuals also increase the mortality risk of their pack-mates, but the magnitude of this burden is comparatively small. The mechanisms by which pack-size offsets survival costs of infection remain unknown and we speculate that it is mediated through enhanced food acquisition and territory defense. This is likely a common phenomenon among other social species and parasites, although it is difficult to detect in systems where infection status cannot be measured continuously over time.

How does Montana do Fish and Wildlife Conservation?

Kurt L. Alt*, retired FWP, International Wildlife Consultant

This presentation may provoke thoughts within our professional society on how to build a more effective fish and wildlife conservation voice in Montana. Like most other State and Provincial fish and wildlife agencies, Montana too is in a transformative period. Implementing change will be counterproductive if the agency minimizes those interests that continue to pay the bills, both financially and politically, for conservation efforts at the State level. Montana can lead the country, by example, in changing the approach of effective hunter and angler engagement with the non-hunting, non-angling community.

Survival and Recruitment of Gray Wolf Pups Before and after Harvest

David E. Ausband*, Montana Cooperative Wildlife Research Unit, University of Montana, Missoula, MT
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Jennifer L. Stenglein, Wisconsin Department of Natural Resources, Madison, WI
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Knowledge about recruitment in a population can be critical when making conservation decisions, particularly for harvested species. Harvest can affect population demography in complex ways and this may be particularly true for species whose successful reproduction is linked with complex social dynamics. We used noninvasive genetic sampling and a natural experiment to estimate recruitment in gray wolves (Canis lupus) before and after harvest in the northern Rocky Mountains, Idaho USA (2008-2013). We hypothesized that recruitment would decline after hunting and trapping began and that the decline in recruitment would be attributable to the harvest of pups and not subtler mechanisms associated with group dynamics and reduced reproductive success. We collected fecal samples from wolves in 10 packs for 6 consecutive years, extracted DNA, and genotyped 154 individual pups across 18 microsatellite loci. Population harvest rates averaged 23.8% (SD = 9.2). Our hypothesis that recruitment would decline was supported; survival from 3 – 15 months of age decreased from 0.60 (95% CI: 0.48-0.72) without harvest to 0.38 (95% CI: 0.28-0.48) with harvest and recruitment declined from 3.2 (95% CI: 2.1-4.3) to 1.6 (95% CI: 1.1-2.1) pups per pack after harvest was initiated. We attributed just 18-38% of pup mortality directly to harvest and suggest that there are indirect effects of harvest on recruitment that may be associated with changes in group size and structure. Models that do not include both direct and indirect effects of harvest on recruitment may underestimate the potential impact of harvest on population growth in social species.

Developing a Monitoring Framework to Estimate Wolf Distribution and Abundance in Southwest Alberta

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Gray wolf (*Canis lupus*) populations are difficult to monitor because wolves can be elusive and occur in low densities. Traditional radiotelemetry-based monitoring methods have limited application when turnover is high within the wolf population and resources to maintain long-term collaring programs are limited. We worked collaboratively with Alberta Environmental Sustainable Resource Development between 2012 and 2014 to develop techniques for monitoring gray wolf populations in the absence of radiotelemetry in southwest Alberta. We surveyed potential rendezvous sites and collected DNA samples from wolf scats for genetic analysis and surveyed hunters for wolf sightings made during the hunting seasons.

We fit false-positive occupancy models to annual detection data derived from genetic results and hunter surveys with Program PRESENCE. We found percent forest cover and human density positively influenced pack occupancy whereas detection probabilities varied by survey method, sampling effort, and sampling season. The model predicted wolf pack occupancy well and distribution and abundance estimates were consistent with agency predictions. While developing the monitoring framework, questions arose regarding pack turnover and population growth under widespread human harvest. Previous studies have focused on population recovery following wolf control actions but little emphasis is put on populations that exist under regular harvest. We will use genetic data to determine how immigration contributes to wolf population trends under a long-term harvest regime and tie this into pack occupancy through colonization and local extinction probabilities. This will expand the application of our occupancy model and will further clarify how wolf populations respond to long-term regulated harvest.

Examining Seasonal Anthrax Risk in Wildlife: Comparing Home Ranges and Site Fidelity in Sero-Positive and Sero-Negative Ungulates

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Anthrax is frequently reported from wildlife and livestock in the US. While useful in reducing risk in livestock, vaccination, the primary method of prevention, is untenable for free-ranging wildlife. Because of this, accurate surveillance and carcass clean-up are the most efficacious control measures for wildlife. However, surveillance is expensive and requires significant personnel across large landscapes. Likewise, the transmission pathways are poorly understood in most species. Wildlife telemetry improves our understanding of movement patterns during risk periods. At the same time, serological surveys provide data on host exposure. Such data allow us to test hypotheses about host/pathogen interactions on the landscape. Starting in 2010, we initiated GPS telemetry and sero-prevalence studies for managed bison, *Bison bison bison*, and free-range elk (*Cervus elaphus*) in Montana. Here we will evaluate summertime home ranges in bulls from both species in western Montana. We compared home ranges and site fidelity metrics in sero-positive and sero-negative animals. Serological tests indicated that ~30% of bull elk and ~27% of unvaccinated bison were sero-positive for anthrax exposure, suggesting that low-level exposure is frequent on this landscape. Seasonal ranges can be useful for defining areas where animals may have increased likelihood of anthrax, comparing ranges to niche-based estimates of *B. anthracis*. Fidelity metrics suggest both species spent considerable time in niche-based high risk areas. Inter-annual data from elk suggest long-term range fidelity and overlap with high risk areas. These

data can be used to prioritize surveillance efforts in those areas to maximize disease control, while managing search costs.

Can Montana Shrews be Identified using Morphology of Dorsal Guard Hairs?

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Several species of shrews present in Montana are considered species of concern by state and federal agencies, primarily due to a lack of information. Current methods for identifying shrew species can be costly, potentially inaccurate, and logistically challenging. We sought to validate a novel methodology developed in the United Kingdom that uses morphological characteristics of dorsal guard hairs for identification of shrew species. Utilizing museum collections at Montana State University and the University of Montana, we sampled dorsal guard hairs from specimens of Montana shrews with known identities. We measured four length and width characteristics for each hair sample and used a discriminate function analysis to calculate the probability of correctly identify a specimen to species. We achieved >80% confidence identifying the pygmy shrew (*Sorex hoyi*), which is a species of concern in Montana, and >70% confidence identifying the Northern short-tailed shrew (*Blarina brevicauda*). To increase our ability to discriminate between species we analyzed subsets of species found within discrete ecoregions and habitats. Within these subsets we achieved >80% confidence identifying the masked shrew (*S. cinereus*), and >60% confidence identifying the dwarf shrew (*S. nanus*). These findings suggest that this new methodology is viable for some species and can provide a simple, affordable research tool for the targeted study of shrews in Montana.

Wolf-Cougar Co-occurrence in the Central Canadian Rocky Mountains

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Cougars and wolves are top predators that can influence the dynamics of an ecosystem, including prey behavior, dynamics, and interspecific competition. I am examining co-occurrence between wolves and cougars in the Central Alberta Rockies using occupancy modeling. I hypothesize that cougars will have lower occupancy of higher quality habitat in the presence of wolves; cougars will be restricted to higher elevations, more rugged terrain, and areas with lower NPP than the areas occupied by wolves. To test this overall hypothesis, we collected data from 167 remote wildlife cameras in Banff, Jasper, and Yoho National Parks and use co-occurrence models to explicitly test the effects of wolves on cougars. We examined co-occurrence between seasons, summer (May 1 – October 31) and winter (Nov 1 – April 30), in seven-day intervals. From naïve occupancy models, summer cougar occupancy was 0.35 with a detection probability of 0.202 and winter occupancy was 0.157 with a detection probability of 0.065. Summer wolf occupancy was 0.625 with a detection probability of 0.209, while winter occupancy was 0.435 with a detection probability of 0.134.

The larger proportional, seasonal decline in cougar occupancy in winter is intriguing because prey density is higher during the winter, meaning cougar-wolf competition may increase during winter; wolf presence may impact both cougar detection and occupancy. Preliminary co-occurrence models support our hypothesis that wolves can potentially outcompete cougars in our system. This study is important because the literature about wolf-cougar co-occurrence provides mixed results: mostly cougars are secondary predators to wolves, but occasionally, cougars are unaffected by wolf presence.

Montana's Bat Acoustic Surveillance Efforts: Pre-White-Nose Syndrome (Oral Presentation and Poster)

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Jake Chaffin, Montana/Dakotas State BLM Office, Billings, MT

Montana's bat species face a wide array of conservation issues that threaten the long-term viability of these populations. The potential arrival of White-Nose Syndrome (WNS) may be the single greatest threat as mortality has exceeded 95% for some bat populations in eastern North America. A collaborative effort was initiated in 2011 to document year-round spatial and temporal activity patterns of Montana's bats prior to WNS arrival. In the last 4 years, we have deployed a network of over 60 Song Meter ultrasonic acoustic detector/recorder stations programmed to record bat passes from sunset to sunrise year-round. Through late December of 2014, these recording stations have resulted in more than 3.9 million full spectrum sound files containing more than 12.5 terabytes of information. Processing and automated analyses have been completed for all sound files and over 30,000 bat passes have been reviewed by hand using an updated Montana bat call characteristics key to definitively confirm the presence of species during each month of the year, identify the lowest temperatures at which individual bat species are active, and track overall bat activity, regardless of species, at each station. Highlights to-date include: 1421 new records of monthly species presence throughout the state, numerous first records of species' activity during the fall, winter, and spring months, numerous first records of species in regions with previously limited bat survey effort, documentation of nightly activity patterns throughout the year and regular winter activity for a few resident species, and the year-round presence of species previously considered migratory.

One-Year Progress Report for the Montana Statewide Bighorn Sheep Research Project

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Restoration and conservation of bighorn sheep has been a challenge. Despite strong conservation efforts, bighorn sheep have not recovered to historic range and numbers as most other ungulates have. The Montana Statewide Bighorn Sheep Research Project, a collaborative effort between Montana Department of Fish Wildlife & Parks and Montana State University, began operations in winter 2013/2014 in order to provide information to

help guide future management and conservation of bighorn sheep. Seven bighorn sheep populations were scheduled to be sampled in the first year of the study and this presentation will outline the accomplishments, challenges, and findings from the first year of the research effort. Research objectives are to quantify and compare exposure to and prevalence of pneumonia pathogens, body condition, habitat use and demographic rates in multiple bighorn sheep populations with varying histories and characteristics across Montana. Study plans and initial findings relevant to these objectives will be presented.

Wolf Disease Summary 2004-2014

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Canine distemper virus (CDV), canine parvovirus (CPV), canine adenovirus (CAV), canine herpesvirus (CHV), neosporosis, leptospirosis, *Brucella abortus* and *B. canis* are diseases that have wolf health or wildlife management implications. Blood serum samples from wolves captured and collared for management purposes between 2004-2014 were screened for these pathogens. Serologic tests for leptospirosis, *B. abortus*, and *B. canis* were completed by the Montana Department of Livestock Diagnostic Laboratory with the remaining tests performed by Cornell University Animal Health Diagnostic Center (Cornell University, AHDC). Samples were assigned as being collected in the Northwest or Southwest region of the state based on capture location and the region designation provided by Montana Fish, Wildlife and Parks wolf specialists. We evaluated and compared pathogen presence and prevalence within Northwest and Southwest Montana. Each disease and its potential implications in the Northwest and Southwest region is discussed.

Pneumonia in Bighorn Sheep: Testing the Super-Spreader Hypothesis

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Following introduction of pneumonia, disease can persist in bighorn sheep (*Ovis canadensis*) populations for decades as annual or sporadic pneumonia epidemics in lambs. Recurring years of depressed recruitment due to high rates of pneumonia-induced mortality

in juveniles is a major obstacle to population recovery. Management strategies for resolving this problem have so far been elusive. We are investigating the feasibility of removing individual "super-spreaders" to improve lamb survival. Individual variation in infection and transmission is well documented in human diseases (e.g. "Typhoid Mary"). We are testing the hypothesis that pneumonia epidemics in lambs are initiated by transmission of pathogens from a few "chronic-shedder" ewes. We have completed the first year of a 5-year project in the Hells Canyon region of Idaho, Oregon, and Washington, and in a captive population at South Dakota State University. Through repeated testing of free-ranging individuals in Hells Canyon, we have identified individual differences in shedding of *Mycoplasma ovipneumoniae*, a primary pathogen in the bighorn sheep respiratory disease complex. We also found that when penned separately in captivity, lambs of ewes that consistently tested positive (chronic shedders) were infected and died of pneumonia, whereas lambs born to ewes from an infected population that tested negative (non-shedders), were not infected and survived. Over the next 4 years we plan to 1) continue and expand testing of free-ranging and captive animals, 2) determine whether removal of chronic-shedder ewes improves lamb survival in free-ranging populations, 3) expand and replicate chronic-shedder commingling experiments in captivity, and 4) establish and monitor a new population founded with non-shedders from an infected population.

Audubon's Birds and Climate Study: From Bioclimatic Envelopes to Implications for Montana

Amy Cilimburg, Director of Bird Conservation and Climate Policy, Montana Audubon, Missoula, MT

This past fall National Audubon Society released an extensive "Birds and Climate" report which modeled future climatic distribution for over 500 North American bird species. In sum, 314 bird species were shown to be significantly imperiled as we move through this century. In Montana, over 230 bird species are at risk. This Birds and Climate report, similar to other recent published studies, uses bioclimatic models to predict future climate envelopes for each species. This presentation will describe what these models predict, how they are used, and how they can be combined and overlain with ecologically sensitive habitat maps. We would like to begin a discussion about their usefulness in bird prioritization and conservation. Can peering into the future with bioclimatic modeling help us plan our habitat projects and efforts toward protecting priority species? Let's start the conversation about their applicability and usefulness to Montana biologists and conservationists.

Updates from the Transportation and Wildlife Front

Patricia Cramer*, Independent Researcher, Logan, UT
Robert Hamlin, Independent Researcher, Logan, UT

Multiple western states are researching how to best mitigate roads for wildlife. We will present updates to ongoing projects in Montana and Utah and several other states. Lessons learned from these projects can be applied to Montana wildlife mitigation. Recent research is learning of mule deer, white-tailed deer, elk, pronghorn, big horn sheep, moose and other wildlife preferences for types of crossing structures. The results show support for the idea that the length of wildlife crossing structures is the most important structural dimension for mule deer success. Results also show a willingness of white-tailed deer to use bridged structures that are under 5 feet high to pass beneath roads. Elk are the "problem child" of wildlife crossing structures in several places, and are very hesitant to use any structures. Pronghorn and bighorn sheep are successfully using wildlife overpasses in three states. The efficacy of the use of double cattle guards and wildlife guards to prevent wildlife access to roads is being

examined in a Utah study. Results will be presented on the effectiveness of these and electric mats at preventing wildlife access and will help elucidate which types of guards would work for various situations. Recommendations for future mitigation types and concerns will be presented at the end of our presentation.

A Review of Parasites and Disease Impacting Moose in North America

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Moose (*Alces alces*) are relative newcomers to North America, believed to have crossed the Beringian land bridge during the late Pleistocene, 10,000–15,000 years ago. Their evolution in Asia may have left them relatively ill-prepared to cope with a suite of North American parasites that have proportionately greater impacts on moose than other cervids. We review the current state of knowledge regarding impacts of parasites on North American moose populations, including brainworm (*Parelaphostrongylus tenuis*), arterial worm (*Elaeophora schneideri*), giant liver fluke (*Fascioloides magna*), winter tick (*Dermacentor albipictus*), and others. We then pay specific attention to recent research and monitoring of moose, parasites, and disease, in the context of potentially declining moose populations in Montana and elsewhere. Notably we have preliminary evidence suggesting minimal impacts of winter ticks in Montana relative to the eastern US, but also a separate and poorly understood parasite- or disease-induced reduction of adult female moose survival in a southwest Montana population. These results are preliminary and we discuss them as yielding more questions than answers thus far.

Summer Habitat Selection and Range Expansion of Non-Native Mountain Goats in the Greater Yellowstone Area

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The ongoing expansion of non-native mountain goat populations throughout the mountainous regions of the greater Yellowstone area (GYA) may pose a threat to species native to this ecosystem, particularly native and restored bighorn sheep populations with a history of vulnerability to overexploitation, habitat loss, and disease die-offs. To inform future management actions and policy on the breadth of mountain goat expansion, we used unique occupancy methodologies to rigorously survey two study areas with established bighorn sheep and mountain goat populations over three summer field seasons (2011-2013), modeled patterns of scale-specific habitat selection, and predicted the ultimate distribution of suitable habitat and abundance of mountain goats for the entire GYA. We recorded 505 mountain goat detections for 53,098 sampling units. Mountain goat occupancy was most strongly related to slope, slope variance, canopy cover, heat load, and NDVI. We predicted extensive suitable habitat for the GYA covering 10,745 km2 and extending throughout the South Absaroka, Teton, Gros Ventre, Wind River, and Wyoming Ranges. We estimated the GYA to support 5,372-8,918 total mountain goats, or about 2.5-4.2 times the current abundance estimate of 2,104. The potential implications to management and conservation of bighorn sheep and mountain goats are addressed.

Estimating Natal Origins of Migratory Juvenile Golden Eagles Using Stable Hydrogen Isotopes

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We used stable hydrogen isotope analysis to estimate the natal origins of juvenile Golden Eagles (*Aquila chrysaetos*) captured during fall migration along the Rocky Mountain Front in Montana, U.S.A. We collected feather samples from 50 hatch-year (juvenile) Golden Eagles at several fall migration sites from 2004 – 2007. We analyzed feathers for their ratio of deuterium (δ^2H_f) described in parts per thousand [‰]. A simple linear regression model was used to calibrate our isotope ratios of migrating eagles to a raptor-specific deuterium base map. This enabled us to make inferences about the natal origins of juvenile Golden Eagles captured during fall migration. Our analysis indicated natal origins ranged from the Brooks Range in Alaska to northern Montana. However, 66% (range 50-76%) of the individuals we sampled likely originated from natal areas located in the Yukon and Northwest Territories, Canada, and a small portion of eastern Alaska ($\leq$ -140 δ^2H_f). We did not observe any passage date differences regarding gender or natal latitudinal origins. Our study supports that stable isotope analysis is effective in aiding researchers to understand natal origins of migratory, juvenile Golden Eagles captured during fall migration, or found as mortalities on wintering grounds. It may also be a useful tool for linking Golden Eagle migration count and trend data with population status when utilized among multiple migration sites and wintering areas throughout North America.

Elk Calf Survival and Elk Population Dynamics in the Southern Bitterroot Valley

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In response to declining elk calf recruitment in the southern Bitterroot Valley of Montana, we initiated a 3-year study to determine the importance of bottom-up and top-down factors for elk calf survival and elk population dynamics. We monitored the survival of 286 elk calves during 2011-2014 in order to estimate cause-specific mortality and calf survival to age 1.We used continuous-time survival modeling to evaluate the effect of risk covariates and estimate calf survival and cause-specific mortality rates. Annual elk calf survival was 0.32 in 2011, 0.43 in 2012, and 0.45 in 2013. We found that mountain lions (20%) were the most important mortality source for elk calves, followed by unknown causes (17%), unknown predation (9%), bear predation (5%), natural, non-predation (4%), wolf predation (3%), and human-related mortality (1%). Male elk calves were at 63% higher risk of mortality than females ($P = 0.01$), and elk calves in the West Fork area were at 42% higher risk of mortality compared to the East Fork ($P = 0.07$) during their first year. Also, we detected a significant positive effect of estimated birth date on summer mortality risk for elk calves ($P = 0.07$). We will use integrated population modeling to combine elk calf and adult female survival, nutrition, and carnivore population data, allowing us to forecast the effect of habitat and carnivore densities on elk population trends. These tools may help managers balance carnivore and ungulate population objectives and is applicable to all areas experiencing carnivore recovery.

The Influence of Snow on Ground Temperatures

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Snow influences temperatures within the snowpack and soil temperatures. Air temperatures may be well below freezing but temperatures within the snowpack and at soil surface will be near 0 ^{0}C (32 ^{0}F). When there is fall green-up and snow covers the vegetation before cold temperatures occur (less than – 5 ^{0}C or 23 ^{0}F), the native forage may stay green into January. With soil surface temperatures near freezing under snow packs that exceed about one meter, organisms can survive extremely cold winter air temperatures. Air temperatures can affect snow consistency as the seasons snowpack is being deposited which can affect foraging and animal movement. Relationships between air temperature, snow temperature and soil temperatures will be presented.

Distribution of Breeding Ducks Relative to Habitat Characteristics in the Prairie Pothole Region of North Central Montana

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Terry L. Shaffer, Northern Prairie Wildlife Research Center, USGS, Jamestown, ND

Continental waterfowl population declines in the early 1980s led to the development and implementation of the North American Waterfowl Management Plan. The plan identified wetland and grassland losses in the Prairie Pothole Region (PPR) of Canada and the United States as the major causes of low continental duck populations. Until 2008, north central Montana was the only remaining PPR area in the United States without a ground-based annual survey to monitor breeding duck populations and quantify breeding duck habitat. The purpose of this study was to establish an annual breeding duck survey in north central Montana to 1) develop species-specific breeding pair predictive models, and 2) apply the models to estimate the distribution of breeding ducks and identify priority areas for conservation. We observed 10539 indicated breeding duck pairs on approximately 675 wetland basins surveyed annually from 2008-2014. A competing models analysis was used to identify local- and landscape-scale habitat characteristics to predict breeding duck pair abundance on wetland basins. The five most commonly observed species were modeled separately; those species were mallard (*Anas platyrhynchos*), northern pintail (*A. acuta*), gadwall (*A. strepera*), northern shoveler (*A. clypeata*) and blue-winged teal (*A. discors*). At the local scale, wetland basin area, the square root transformation of wetland basin area, and wetland basin class were important predictors for all species. Important model predictors varied by species at the landscape scale. We applied the models in a GIS to develop a decision support tool for conservation actions funded by the Migratory Bird Conservation Fund.

Partners of the Americas Montana-Patagonia Chapter: Challenges, Directions, and Successes

Melissa A. Foster, Secretary/Treasurer, Montana Chapter of Partners of the Americas

From the steppe to the Andes, the small towns to the big ranches, outdoor tourism to oil and gas development, Patagonia has a lot in common with Montana. Partners of the Americas (POA) is a nonprofit organization that pairs regions in North and South America to share culture, foster understanding, identify common ground, and develop unique solutions

to local challenges. The projects undertaken by various POA chapters are as diverse as their membership and range from exchanges of professionals (e.g., doctors, lawyers, teachers, law enforcement) to charity activities (e.g., school building, clean water) to language learning. The Montana-Patagonia chapter of POA is comprised mostly of biologists and the majority of exchanges over the past 25 years have been related to wildlife management. Last fall, I traveled to Junín, San Martín, and Bariloche, Argentina and met with over 20 biologists from state and federal agencies, universities, and nonprofits to fortify the Montana-Patagonia partnership and help illuminate a path for the future. I'll discuss the history of the Montana-Patagonia partnership, and highlight important biological challenges in Patagonia such as problems with exotic species—especially red deer, mink, trout, and a variety of plants—and declining native species such as the huemul and pudú (deer) and huillín (otter). Other challenges include conflicts between ranchers and wild felids like the Andean cat, the lack of a public trust doctrine, habitat loss, and poaching. Finally I'll talk about where Partners is headed and how to get involved in this exciting partnership.

Approaches Initiated to Gain Insight into Respiratory Disease in Montana's Bighorn Sheep Herds

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Respiratory disease is a major limiting factor in the restoration, conservation, and management of bighorn sheep in Montana and throughout western North America. Despite many decades of research there is a limited understanding of the disease process, with proactive management to minimize disease primarily limited to establishing policies to minimize exposure of bighorn sheep to domestic sheep. In the past decade, however, there have been significant advances in understanding the pathogens involved in bighorn sheep pneumonia that have resulted in the development of new sampling and testing methodologies that promise to advance our understanding of the disease. This presentation will review the general ideas regarding the pathogens and the disease process advanced by leading researchers of bighorn sheep pneumonia and describe how these ideas are being combined with recent sampling and testing advances and incorporated into Montana's state-wide bighorn sheep research program. We will also describe the collaborations developed between our research team and other research teams addressing the same questions in neighboring states. These collaborations are an attempt to build a regional initiative that combines the resources, expertise, and unique management histories of bighorn herds in other states. We think such open communication and coordination of research activities will help us advance our understanding of bighorn sheep pneumonia and develop management strategies that can enhance restoration of the species.

Monitoring Responses of Bear Foods to Climate Change Evaluating Adaptive Monitoring Designs for Occupancy Studies

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Mevin B. Hooten, USGS, Colorado Cooperative Fish and Wildlife Research Unit, Department of Fish, Wildlife, and Conservation Biology and Department of Statistics, Colorado State University, Fort Collins, CO

Methods for assessing site occupancy while accounting for imperfect detection have quickly become important for ecologists wishing to study the distribution and prevalence of species across landscapes. Occupancy data are convenient to collect because, while they do require repeated sampling efforts, they do not require the marking of individual organisms. Some guidance on monitoring for occupancy studies has been provided for conventional settings. However, coupling the data collection and analysis components via an optimal adaptive sampling design may improve precision of estimates and save money. Optimal adaptive sampling designs have not been applied to occupancy models previously. We present a design criterion that facilitates adaptive monitoring for occupancy studies and illustrate its advantages and disadvantages through the use of simulations and real-data scenarios. Our findings indicate that, depending on the focus of the study in question, monitoring designs can be improved substantially by considering adaptive sampling schemes.

Assessing Integrated Carnivore-Ungulate Management in the Bitterroot Valley

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Whether increasing large carnivore harvest can increase ungulate populations is uncertain for several reasons. One primary ecological uncertainty is whether carnivores limit ungulate population dynamics. A second results from partial controllability of large carnivore populations; whether large carnivore hunting seasons will reduce carnivores to the extent that ungulates increase. We first review cases of 'integrated carnivore-ungulate' management from western North America, highlighting where key uncertainties were addressed. Then, using the Bitterroot valley of MT as a case study, we present results from a research project designed to provide quantitative measurements of (1) elk population dynamics and limiting factors, (2) mountain lion densities, (3) the effect of harvest on mountain lion densities under a management plan designed to differentially affect lion density across western Montana, and (4) the ultimate effect of changes in mountain lion seasons on elk population dynamics. During the first phase of research, mountain lions caused 6-8 times more mortality than wolves, limiting elk populations via calf survival and recruitment. We estimated mountain lion densities in the Bitterroot and Granite County to help address scientific uncertainty, the effect of lion hunting on lion densities and ultimately elk recruitment and populations. In 2016, following implementation of 4 years of mountain lion seasons intended to reduce lion density in the Bitterroot and stabilize lion density in Granite county, we plan to return to the Bitterroot to monitor both lion and ungulate populations to quantify the effects of this integrated carnivore-elk management strategy. This research will provide objective information to inform public decision-making processes about carnivore and elk management, but it cannot provide direction regarding what strategy for carnivore or elk management should be pursued. Balancing the input and desires of divergent stakeholders is perhaps the most challenging facet surrounding integrated carnivore-elk management.

Habitat Quality Influences Migratory Strategy of Female White Tailed Deer

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Partial migration is a life history strategy that is common for ungulate species living in seasonal environments. One factor that influences the decision to migrate by ungulates is access to high quality habitat. We evaluated the influence of access to winter habitat of high quality on the probability of an individual migrating, seasonal habitat use between and within migratory and resident classes of deer, and the effects of this decision on the survival of female white-tailed deer. We radio-collared 67 female white-tailed deer (*Odocoileus virginianus*) in 2012 and 2013. The odds of being a migrant increased as home range size increased and decreased as proportion of cropland within home range in winter increased. The habitat with the highest relative probability of use in winter for residents was pasture (1.00, SD = 0.01) and for migrants was riparian (0.73, SD = 0.39). In summer both groups had the highest relative probability of using pasture (resident = 0.96, SD = 0.15; migrant = 0.99, SD = 0.08). We integrated the migration probability and survival models to estimate annual and seasonal survival rates of migrants and residents. We found no difference between the annual and seasonal rates of survival for the different migration strategies. Our results indicate that access to habitat of high quality may be a strong influence on a female white-tailed deer's decision to migrate. We suggest the presence of partial migration in a population may be a response to competition for high quality habitat.

Habitat Selection by Chiricahua Leopard Frogs During Summer Monsoons

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One-third of the described species of amphibians worldwide are threatened with extinction, including the Chiricahua leopard frog (*Lithobates chiricahuensis*). This frog is highly aquatic, found in portions of Arizona and New Mexico, and listed as threatened under the Endangered Species Act. Currently, the Chiricahua leopard frog is restricted to anthropogenic sources of water, including tanks maintained for livestock, throughout most of its range. Movement habits of this frog and patterns of dispersal between disjunct water sources are not well understood. We attached radio transmitters to 44 total frogs on the Ladder Ranch in southern New Mexico during summer 2014 and located each frog daily for up to 8 weeks (mean = 29 days). We quantified habitat characteristics at each frog location and a random location 5 meters away. We assessed fine-scale habitat selection using conditional logistic regression and also explored the degree of variation in selection among individual frogs. Frogs chose areas with more low-lying cover (especially aquatic vegetation and woody debris), less overstory cover, and a mud substrate. Whether the location was far from or close to water and the amount of overstory cover did not appear to be important for selection, suggesting that frogs are able to find areas that provide habitat away from water

bodies. The variation among individuals was low, suggesting that tracked were selecting similar habitat characteristics. The findings of this study will inform active management of amphibians in anthropogenic settings, where managers can enhance amphibian habitat characteristics between occupied sites to improve population connectivity.

Assessing Brucellosis Seroprevalence and Transmission Risk in a Free-Ranging Elk Population: The Targetted Brucellosis Surveillance Project in Montana

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Brucellosis is a bacterial disease that affects elk, bison and domestic cattle. Recently the seroprevalence of brucellosis in free-ranging elk populations of Montana has increased and its' range has expanded, resulting in increased pressure on Montana Fish, Wildlife and Parks (MFWP) to manage the disease in elk. In 2010 MFWP and the Montana Department of Livestock initiated a targeted surveillance program to delineate the current geographic distribution of brucellosis, document spatio-temporal habitat selection and movement patterns, and to quantify potential transmission risk from elk to cattle. Since 2010, we have targeted 11 different winter ranges from 9 hunt districts, both within and outside of the Designated Surveillance Area used to manage cattle. During each capture operation we tested approximately 100 adult female elk for exposure to brucellosis. We deployed GPS radiocollars on a subsample of adult female elk on each winter range. An epidemiological summary of the first five years, including seroprevalence, movement and implications for transmission vectors will be presented. Current brucellosis exposure in domestic herds, future surveillance areas, evaluation of various management actions on transmission risk, and the creation of a spatio-temporal risk model are discussed.

Home-Range Size of White-Headed Woodpeckers in West-Central Idaho

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The white-headed woodpecker (*Picoides albolarvatus*) is a species of management concern in dry-conifer forests of the Inland Northwest, where forest restoration and fuels reduction treatments are increasingly common. This species may be vulnerable to forest management treatments because it occupies a limited distribution and has narrow habitat requirements. Forest treatments could negatively affect this species if foraging and nesting resources are removed or could benefit the species through creation of more heterogeneity across the landscape. Studies of other woodpecker species have identified resource availability and habitat composition as a key influence on the variation of home range size within a population. We examined home range size of white-headed woodpeckers in a

landscape historically managed for timber harvest and is currently receiving extensive forest restoration treatments. In our first field season, we obtained relocations on 7 radio-tagged woodpeckers (5 males and 2 females, all from different breeding pairs), from late nesting through fledgling periods (late June to early September). We obtained direct foraging observations at the radio locations. Estimated home range sizes were quite variable(24 - 180 ha), based on the minimum convex polygon (MCP) method. We will also estimate home range sizes using the fixed-kernel method. Identifying habitat spatial attributes that account for variation in home range size will contribute towards effective management decisions for the persistence of white-headed woodpecker populations.

Mountain Plover Population Trends in 3 Montana Areas

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Permanent point count transects were established in 1992 in central, northeastern and southwestern Montana to monitor mountain plover population trends in these areas. At the time, these were considered to be Montana's 2nd, 3rd and 4th largest mountain plover populations. During the 23 year period from 1992 to 2014, these transects were surveyed during 10 different years with the last counts for the Central and Northeastern Montana Study Areas occurring in 2014, and the last count for the Southwestern Montana Study area occurring in 2004. The count of adult mountain plovers in the Central Study Area declined from 103 adult birds in 1992 to 13 birds in 2014. In the Northeastern Study Area, mountain plover started at 17 in 1992, peaked at 36 in 1996, dipped to 12 in 2004, and ended with a final count of 17 in 2014. Mountain plover numbers in the Southwestern Study Area progressively declined from a high of 33 adult birds in 1992 to no birds found in the Study Area in 2004. Cause of mountain plover decline in the Central Study Area was attributed to conversion of native grasslands to cultivated cropland and introduced grasses, a drastic decline in domestic sheep numbers, and an overall reduction in livestock grazing. In the Southwestern study area, the collapse of the mountain plover population was attributed to a housing development, a log home factory, prairie dog poisoning, and the lack of livestock grazing. The Northeastern Study Area was almost entirely public lands with relatively stable habitat conditions.

Effects of Oil and Gas Development on Mule Deer Populations in Western North Dakota and Eastern Montana

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Oil and gas production are becoming a significant part of the economy and landscape of western North Dakota and eastern Montana. Much of the areas being developed overlap with mule deer ranges. Our ongoing research aims to identify and quantify the direct and indirect effects of oil and gas energy development on mule deer abundance, survival, recruitment, movements and resource selection. Since February, 2013, we have deployed 240 GPS collars in three main areas of breaks habitat: 1) in North Dakota along the Little Missouri River; 2) the east side of the Yellowstone River; and 3) just south of Culbertson, MT. These collars are being used to collect spatial data about mule deer distributions and monitor survival across areas of low, medium, high energy development. We will also use digitized aerial survey data to estimate abundance and recruitment across various levels of development. To date we

have collared 99 adult females and 110 fawns, gathering more than 300,000 deer locations, conducted 39 lab necropsies on full and partial carcasses, and conducted biannual aerial surveys in North Dakota (2 years) and Montana (1 year). Our research will address potential impacts to mule deer populations, but will also provide mitigation strategies to help minimize disturbances from further development.

Impacts of Aspen and Conifer Vegetation on Predation Risk and Distributions of Bird Species

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Aspen forests are in decline around the globe and are largely being replaced by conifers. Associated with this shift in forest composition, we document an increase in nest predation risk and decrease in abundance of bird species that breed in aspens. These observational data from 5 years across 19 forest stands in western Montana were verified with an adaptive management experiment removing all conifers from three large aspen stands in the Mt. Haggin WMA. This landscape-scale approach strongly supports the active management of aspen stands, by such methods as removing conifers, to improve breeding bird habitat. Our results also suggest that vegetation-mediated effects of predation are associated with avian distributions and species turnover.

Identifying Potential Breeding Areas of Short-Eared Owls Prior to Nesting Using Roadside Surveys to Detect Courtship and Territoriality Behavior: A Comparison of Visual and Audio Techniques

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We piloted a roadside survey technique for detecting Short-eared Owls during the courtship period in western Montana. Thirty-five surveys were conducted between 2009 and 2012 and were timed to coincide with pair-formation and courtship behavior. Short-eared Owls perform courtship flights and vocalizations which can be observed and heard during the crepuscular period. Surveys were designed to compare visual and audio survey techniques. Visual surveys occurred during the crepuscular period at the end of civil twilight and were immediately followed by a nocturnal audio survey. Visual survey techniques accounted for over 91% (N=240) of all detections. Detections associated with audio survey techniques were almost always associated with survey points where at least one owl was detected during visual survey. Nearly three-quarters of visual detections (N=220) occurred between 30 and 70 min before the end of civil twilight. Over 75% of visual detections and 90% of nocturnal detections occurred in areas where vegetation was uncut and ungrazed and most frequently associated with vegetation heights greater than approximately 60cm. Short-eared Owls were never detected in areas where livestock was present. We recommend visual surveys during the courtship to identify potential breeding areas prior to the onset of incubation.

Two Out of Three Ain't Bad: 3 Year Progress Report of Multi-Species Non-Invasive Montioring of Forest Carnivores in the Southwest Crown of the Continent

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The Southwestern Crown of the Continent is a 1.5 million acre landscape in western Montana that has been the focus of collaborative forest restoration since 2010. Monitoring the effects on forest carnivores of forest restoration efforts can aid land management decisions significantly. A multi-party working group initiated field work to collect baseline information regarding the distribution and relative abundance of forest carnivores across the Southwestern Crown. In the winters of 2012-2014, we employed non-invasive detection methods, including systematic grid-based snowtrack surveys (with backtracking to obtain genetic samples), combined with baited DNA snares and camera traps, to detect target species, including lynx (*Lynx canadensis*), wolverine (*Gulo gulo*), and fisher (*Pekania pennanti*). We surveyed 82 of the 129 5 x 5 mile grid cells in the study area, resulting in 3,366 miles of track surveys, and 274+ bait stations. We detected lynx in 35 cells and wolverine in 38 cells. The number of cells where lynx were detected was consistent between survey years, while the number of wolverine detection cells increased each survey year. We did not detect any fisher in the study area. Genetics have identified at least 18 individual lynx (13 M, 5 F) and 15 individual wolverines (6 M, 9 F). The combination of two detection methods improved our ability to detect species, including non-target species, compared with either method alone. Our methods could be deployed more widely in Montana.

Wildlife Health Surveillance on the National Bison Range – Monitoring for M. Paratuberculosis in Bison

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The wildlife health surveillance program on the National Bison Range was designed to assess the presence and prevalence of diseases in wildlife populations. Annual sampling and disease testing has been conducted at the range for decades. Starting in 2000, a statistically derived disease detection model for bison was designed and implemented to enhance detection of several diseases, including M. paratuberculosis. This disease, commonly known as Johne's disease, is a bacterial intestinal disease that causes diarrhea, severe weight loss, and eventual death in bison and cattle. Targeting analysis of both populations as a whole and the status of individual animals, the program includes; (1) year-round direct observations aimed at detecting acute injuries, chronic conditions, mortalities, and emerging disease, and (2) regular diagnostic laboratory testing for a suite of diseases of particular concern and to evaluate exposure to several viral, parasitic and bacterial diseases common in the cattle industry. Information from direct observation is documented and shared with staff experienced in dealing with injuries, mortalities, and necropsies. Diagnostic analysis depends on routine

coordination with our wildlife health office in Bozeman, Montana, by providing guidance concerning disease or other life-threatening conditions, and annual summary analysis of data. This is a long term adaptive process that includes periodically assessing local and regional wildlife threats, updating protocols according to sample results and providing management with necessary information to maintain healthy wildlife populations within a fenced boundary.

**An Initial Inquiry Into Mountain Ungulate Space Use Within the Greater Yellowstone Area

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The expansion of mountain goats (*Oreamnos americanus*) throughout the Greater Yellowstone Area (GYA) has continued since their initial introduction in the 1940's. Mountain goats occupy similar habitats as native bighorn sheep (*Ovis canadensis*) and harbor pathogens known to be detrimental to bighorn sheep recovery efforts. In 2006 the Greater Yellowstone Area Mountain Ungulate Project initiated a large-scale collaring effort to enhance our understanding of the spatial dynamics of both species and the potential impacts of mountain goat range expansion on regional bighorn sheep. The research is unique in spatial scale and encompasses ten study areas with examples of both sympatric and allopatric mountain ungulate populations. To date we have instrumented 122 individuals (76 BHS and 46 MTGs) with GPS collars and have recovered 45 collars (22 BHS and 23 MTGs) from the field. Initial inquiries into space use across species and study areas with respect to seasonal migrations and elevational changes will be discussed. An early investigation of the heterogeneity in mountain ungulate space use and movement strategies throughout the GYA will help to inform future capture efforts and provide insights into mountain ungulate competition across space and time.

Hantavirus Outbreaks in Deer Mice in Montana May Be Predictable Based on Mouse Population Dynamics

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Sin Nombre hantavirus (SNV) is a rodent-borne virus that causes hantavirus pulmonary syndrome in humans, which has a 37% mortality rate. There is no vaccine or cure, therefore the best strategy is to prevent spillover from rodent hosts. Understanding the ecological drivers of infection in rodent populations can lead to better predictive models of disease dynamics in the reservoir and consequent risk to humans. Using an epidemiological model parameterized and cross-validated using a long term dataset from Montana, I show how environmental variation and fluctuating mouse density affects hantavirus prevalence. I provide evidence for a critical host density necessary to sustain transmission and show how there can be long delays between peaks in density and subsequent peaks in infection prevalence. The lengths of these delays vary with density but are predictable. This means that outbreaks may sometimes be predictable many months in advance. These same principles should also apply to many other disease systems in wildlife with fluctuating populations, and may help predict and mitigate wildlife disease.

Use of an Electro-Optic/Infrared Imaging System for Grizzly Bear Management in Northwest Montana

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Aerial monitoring of grizzly bears in the dense forests and shrub fields of northwest Montana can be difficult. It is important to get visuals on grizzly bears to count cubs, locate dens, and to find injured or dead bears. Even from the air, radio-collared grizzly bears can be difficult to observe. During 2013 and 2014, we had the opportunity to use the services of the Two Bear Air Bell 429 Helicopter and their L-3 WESCAM MX-10 Electro-Optic/Infrared (EO/IR) imaging system. Two Bear Air provides philanthropic aviation support for search and rescue teams in Flathead County and other agencies. We partnered with Two Bear Air to help provide targeted training for their camera operator and they provided us with the opportunity to locate and monitor grizzly bears. During flights we located and observed radio-collared and non-collared grizzly bears and their offspring, pinpointed den sites, and found grizzly bears that had been shot. The advantages of the EO/IR camera system allowed us to locate and monitor grizzly bears from a long distance, record locations, switch between daylight and infrared camera mode to locate bears under the forest canopy. We were able to locate a dead female grizzly bear almost 24 hours after she had been shot. In one case, we were able to look into a grizzly bear den with the infrared camera and see both the female one cub. In addition to grizzly bears, the EO/IR system could be used for monitoring and recording many other species of wildlife.

2014 Statewide Winter Owl Surveys (Oral Presentation and Poster)

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Lauri Hanauska-Brown, Montana Fish, Wildlife, and Parks, Helena, MT

Localized winter owl surveys have been conducted in Montana in the past, but a coordinated statewide effort had never been undertaken. Eleven owl species were, therefore, listed as Species of Highest Inventory Need by Montana Fish, Wildlife, and Parks and the Montana Natural Heritage Program. We coordinated statewide winter owl call surveys in 180 of the 185 quarter latitude/longitude (QLL) blocks that encompass Montana. Call transects each consisted of 10 call stations spaced at 1-mile intervals along a 9-mile long road transect within a QLL block. At each call station, observers alternately silently listened for owl calls and played owl calls for species likely to occur in the surrounding habitat. A total of 1,829 call stations were surveyed and a total of 511 owls across 11 owl species were detected. Detections during the 2014 surveys nearly, or more than, doubled the number of records with indirect evidence for breeding that have been gathered in Montana across all time for Eastern Screech-Owl, Great Horned Owl, Long-eared Owl, and Short-eared Owl. We recommend that these species and the Northern Saw-whet Owl be removed from the Montana Species of Highest Inventory Need as a result of the information gathered during these surveys.

Montana's Winter Bat Roost and White-Nose Syndrome Surveillance Efforts (Oral Presentation and Poster)

Bryce Maxell*, Montana Natural Heritage Program, Helena, MT
Shannon Hilty, Montana Natural Heritage Program, Helena, MT
Lauri Hanauska-Brown, Montana Fish, Wildlife, and Parks, Helena, MT

Amie Shovlain, Beaverhead-Deerlodge National Forest, Dillon, MT
Jake Chaffin, Montana/Dakotas State BLM Office, Billings, MT
Chris Servheen, U.S. Fish and Wildlife Service, Missoula, MT
Bigfork High School Cave Club, http://bigforkhighschoolcaveclub.weebly.com
Northern Rocky Mountain Grotto, http://nrmg.cavesofmontana.org

White-Nose Syndrome (WNS), caused by the cold-adapted soil fungus *Pseudogymnoascus destructans*, has killed an estimated 5.7 to 6.7 million bats in eastern North America since 2006 and has spread westward to states along the Mississippi River corridor as well as the province of Ontario. With at least 9 of Montana's 15 known bat species facing potentially devastating increases in mortality from WNS, a collaborative effort was initiated in the fall of 2011 to document the species composition, number, degree of clustering, and roost temperatures and humidities of bats winter roosting in caves and mines. To-date, collaborators have surveyed over 50 caves and mines, deploying over 30 temperature and relative humidity data loggers near winter roosting bats; most known bat hibernacula in Montana are now being monitored. Most caves and mines surveyed to date support only small numbers of winter roosting bats; typically less than ten roosting in isolation or clusters of two to three. A handful of caves have 50-1750 winter roosting bats with clusters of up to 40 individuals. Many of the caves that have been surveyed have temperatures and humidities that appear to be capable of supporting *P. destructans*, but PCR-based testing of bat and substrate swabs have tested negative for its presence so far. The majority of Montana bats apparently winter roost away from mines or caves that are accessible to, or known by, humans and these roosts need to be located and assessed for their ability to support *P. destructans*.

Field Trials to Determine the Efficacy of an Oral Plague Vaccine for Prairie Dogs

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Marc R. Matchett, USFWS, Charles M. Russell National Wildlife Refuge, Lewistown, MT
Dean E. Biggins, USGS, Fort Collins Science Center, Fort Collins, CO,
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North American prairie dogs (*Cynomys* spp.) and black-footed ferrets (*Mustela nigripes*) have been severely affected by plague, an exotic zoonotic disease caused by the bacterium Yersinia pestis during the last 100 years. Plague has contributed to population declines of prairie dogs, near extinction of black-footed ferrets, and has caused human illness and fatalities. An oral sylvatic plague vaccine (SPV) developed and tested jointly by the U.S. Geological Survey, National Wildlife Health Center and University of Wisconsin (Madison, WI) shows great promise as an effective, pre-emptive method for controlling plague in prairie dogs. Field trials to evaluate the efficacy of SPV were initiated in 2013 and include 4 species of prairie dogs on study areas in 7 states, including Montana. This presentation is a status report after the second year of a planned 4 year study. The primary objectives are to measure vaccine/bait uptake and to assess prairie dog survival rates at paired study sites, with and without vaccine application. At the north-central Montana study site, about 8,000 baits, half with SPV and half placebos, were distributed across 5 pairs of study sites (totaling 81 ha) in 2013 and over 13,000 in 2014 on the same 5 pairs of study sites (totaling 107 ha). In addition to ear tagging and microchip-marking each individual, flea, hair, whisker and blood samples were collected each year. A total of 584 individual prairie dogs were marked during 929 capture events in 2013 and 814 individuals during 1,293 capture events in 2014.

Attitudes Toward Brucellosis Management Tools Among Montana Hunters, Landowners, and Residents

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Justin Gude, Montana Fish, Wildlife, and Parks, Helena, MT

Wildlife management agencies often balance the effectiveness of management actions with their public acceptability. We measured the acceptability and level of agreement among different stakeholder groups for elk (*Cervus Canadensis*) management in MT. The area of highest concern for Brucellosis in MT is known as the Designated Surveillance Area (DSA). MT Fish, Wildlife, and Parks (FWP) has considered several management actions within the DSA and in more targeted geographic locations (e.g., specific valleys) including fencing to prevent comingling of cattle and elk, hazing elk off private property, kill permits issued to landowners, disease management hunts, and others. To understand the acceptability of these management actions we conducted a survey of landowners, hunters, and the general public across MT; the sample was stratified to include respondents in these groups from inside and outside the DSA. The Potential for Conflict Index (PCI) was used to explore differences of acceptability of different management actions under eight scenarios. Scenarios varied based on the status of elk infection; status of cattle infection; comingling of elk and cattle; status of elk population size (i.e., below or above objective); and public hunting access provided by private landowners. Results indicated acceptability of management tools varied by group. Increasing risk of infection also affected acceptability. Understanding the acceptability of these management tools and how acceptability varied based on context informed agency decision making with regard to elk management. Demonstrating contrasts in acceptability among stakeholder groups helped identify areas of disagreement and focus conflict resolution efforts.

Raptor Electrocutions on Power Lines

Sam Milodragovich, Environmental Department, NorthWestern Energy, Butte, MT

Raptors commonly perch on power poles across Montana. Occasionally this results in the electrocution of a raptor. Electric Utilities, Electric Cooperatives, agencies and NGO's are working together to share information and reduce risks to raptors and other birds on electric systems across Montana. This presentation will discuss why raptors use power poles, what the risk factors are, what electric utilities can do to prevent electrocutions and what we as biologists can do when we encounter a dead bird under a power pole.

Elk, Cervus Elaphus, Resource Selection and Implications for Anthrax Management in Southwest Montana

Lillian R. Morris**, University of Florida, Department of Geography, Emerging Pathogens Institute, Gainesville, FL
Kelly M. Proffitt , Montana Fish Wildlife and Parks, Bozeman, MT
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Jason K. Blackburn, University of Florida, Department of Geography, Emerging Pathogens Institute, Gainesville, FL

Anthrax, caused by the spore forming bacterium *Bacillus anthracis*, is a zoonotic disease that affects humans and animals throughout the world. In North America, anthrax outbreaks occur in livestock and increasingly wildlife species. Vaccine administration in wildlife is untenable, and the most effective form of management in wildlife is surveillance and decontamination of carcasses. Successful management is critical, as untreated carcasses can create infectious zones increasing risk for other susceptible hosts. This study focused on informing management in a re-emerging anthrax zone in southwest Montana. In 2008, a large anthrax epizootic primarily affected a domestic bison, *Bison bison*, herd and the bull segment of a free ranging elk, *Cervus elephus*, herd in southwestern Montana. Following the outbreak, we initiated a telemetry study on elk to evaluate resource selection during the anthrax season in an effort to inform anthrax management. A mixed effects generalized linear model (GLM) was used to estimate resource selection by bull elk, and habitat preferences were mapped across the landscape. Preferred habitats were overlaid on ecological niche model-based estimates of B. anthracis presence. We found significant overlap between areas with a high predicted probability of bull elk use and *B. anthracis* potential. These potentially risky areas of elk and *B. anthracis* overlap are broadly spread over both public and private lands. Future outbreaks in the region are probable, and this analysis identified the spatial extent of the risk area in the region, which can be used to prioritize anthrax surveillance.

A Forty Year Odyssey with Montana Wolves: Beginnings Through Five Years of State Management

Robert R. Ream*, College Of Forestry And Conservation, University Of Montana, Missoula, Mt
Justin Gude, Montana Fish, Wildlife And Parks, Helena, Mt

This study traces wolf population growth in Montana from initial searches for wolves in 1973, through the first wolf radio-collared in the North Fork Flathead in 1979 up to the 2014 population. Reintroduction of wolves to Yellowstone NP and Central Idaho in 1995 and 1996 resulted in two “non-essential experimental” Montana recovery areas in addition to the Northwest Montana “endangered” recovery area. From early in wolf recovery to present, livestock depredation control actions have removed individuals or packs from the population. The first public harvest of wolves began in 2009, was stopped by legal action in 2010 and resumed in 2011 to present. The Montana population appears to have leveled off at approximately 700-900 wolves. Minimum counts peaked at 653 in 2011 and have been approximately 625 wolves for the last two years. Approximately 60% of Montana’s wolves occupy the Northwest Montana recovery area. Through the 5 years state harvests have been conducted, harvest quotas and restrictions on methods of take have been gradually relaxed. However, those changes have resulted in relatively little change in harvest or in Montana’s wolf population. Wolf depredation control actions have decreased since the advent of public harvests. Wolves are here to stay at about the current population level, assuming no drastic changes in public harvests or wolf control actions.

Montana Climate Change and Big Game: Things Were Better When They Were Worse

Robert R. Ream, Professor Emeritus, College of Forestry and Conservation, University of Montana, Missoula, MT

Climate change may influence wildlife populations more than any management challenge in recent history. Within the past year numerous reports and papers have come out relative to wildlife and climate change. Now is the time to start addressing the impacts of these changes in Montana. This paper discusses some of the ways climate change may impact big game populations relative to recent climate data sets for Montana. Length of growing season, winter severity, time of spring green-up, summer heat, drought, all may have direct or indirect impacts on wildlife populations. Indirect impacts include disease and disease vectors. Recent declines in some of our big game species may be attributed in part to climate change. Hunting quotas and seasons have been modified to ameliorate some of the population changes. We must be proactive in assessing the impacts of climate change on Montana wildlife populations in order to apply adaptive management.

Identifying Priority Areas for Chronic Wasting Disease Surveillance in Montana

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Chronic Wasting Disease is a fatal prion disease affecting ungulate species throughout North America. As of 2013, no CWD positive deer have been found in the state of Montana, however, several surrounding states and provinces have identified multiple cases of the disease. We used information on mule deer habitat selection, abundance, and locations of CWD cases in surrounding states to identify priority areas in Montana for CWD surveillance. The habitat selection models were based on over 10000 VHF and GPS locations collected from mule deer from 1975-2011, and predicted resource selection function (RSF) values for winter and summer in 5 of the 7 wildlife management regions in the state of Montana. We estimated mule deer density using the aerial survey counts weighted by the value of the RSF for each pixel. High priority areas were those that contained the highest densities of mule deer and were closest to locations with CWD positive deer. This information can be used to inform Montana's CWD surveillance program for mule deer. We concluded that based on mule deer distribution and movement patterns several mule deer herds in Montana were at risk of coming into contact with deer from known infected herds.

Bat Activity Patterns and Roost Selection in Managed Forests

Nathan A. Schwab *, ABR, Inc., Missoula, MT
Lorin L. Hicks, Plum Creek Timber Company, Columbia Falls, MT

The recent introduction and subsequent westward spread of white-nose syndrome (WNS) has decimated hibernating bat populations in eastern North America and created an urgent need for scientists to understand basic information about bat ecology, especially during the winter season. White-nose syndrome has killed between 5 and 7 million bats and continues to

spread westward from the eastern U.S. and southern Canada, primarily affecting bats during hibernation. Acoustic monitoring has been suggested as a potential surveillance tool for detecting WNS; however, baseline information must first be collected to test this technique. We initiated a pilot project in June 2014 by deploying 2 remote acoustic monitoring stations in western Montana's managed forests collecting baseline acoustic information. We also conducted radio telemetry to determine characteristics of roosts used by bats during the fall season. Thus far we have recorded 11 of Montana's 15 bat species, and observed extremely high activity levels during the summer. We radio-tagged 5 bats of 3 different species (California myotis, Western small-footed myotis, Silver-haired bat) and tracked them in late October and early November. Identifying the characteristics of roost sites used during the pre-hibernation period, and the annual activity patterns determined from acoustic monitoring, begin to form the foundation for understanding basic aspects of bat ecology during the season when Montana bats will be most susceptible to WNS.

Modeling Proactive Decisions to Manage Pneumonia Epizootics in Bighorn Sheep

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Pneumonia epizootics in bighorn sheep (*Ovis canadensis*) are a major challenge for wildlife agencies due to the complexity of the disease, long-term impacts, and lack of tools to manage risk. We developed a decision model to facilitate proactive management of pneumonia epizootics in bighorn sheep in Montana. Our decision model integrates a risk model to predict probability of pneumonia epizootics based on identified risk factors. It uses a structured decision making (SDM) approach to analyze potential decisions based on predictions from the risk model, herd-specific management objectives, and predicted consequences and trade-offs. We demonstrated our model's use with an analysis of representative herds and analyzed the recommended decisions to understand them clearly. We learned that proactive management for each herd was expected to outperform in meeting multiple, competing management objectives compared to ongoing status quo management. Based on sensitivity analyses, we also learned that the recommended decisions were relatively robust with limited sensitivity to variations in model inputs and uncertainties; we expect this to be the case in future analyses as well. Our decision model addressed the challenges of uncertainty, risk tolerance, and the multi-objective nature of management of bighorn sheep while providing a consistent, transparent, and deliberative approach for making decisions for each herd. It is a unique tool for managing pneumonia epizootics using an accessible framework for biologists and managers. Our work also provides a case study for developing similar SDM-based decision models, particularly for other wildlife diseases, to address challenges of making complex decisions.

Elk Movements and Harvest Across Public and Private Lands in the Sapphire Mountains

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Hunting access issues have become increasingly contentious as changes in land ownership and use have influenced elk distributions in some areas. In the Sapphire Mountains of western Montana, hunters have voiced concerns regarding elk aggregations on privately-owned lands that restrict hunter access. To address these concerns, we initiated a survey of landowners and hunters to determine satisfaction with elk management. We also radiocollared 65 elk (45 cows, 20 bulls) to better understand elk distributions across public and private lands. In all seasons, bull elk locations were more likely to occur in publicly accessible areas than cow elk locations. During archery season, 61% of bull locations and 41% of cow locations occurred in publicly accessible areas. These numbers dropped to 48% of bull locations and 14% of cow locations in publicly accessible areas during rifle season. During archery and rifle seasons combined, 1 of 39 radiocollared cows (2.4%) was harvested on private land, and 5 of 19 radiocollared bulls (26.3%) were harvested: 3 on publicly accessible land and 2 on private land. Although hunters reported a lack of elk on public lands as a concern, our radiocollar and harvest data confirm that at least a segment of the bull population was accessible to public hunters, but female elk were aggregated in areas that restricted hunter access. A lack of hunter access to female elk during the hunting season may result in management challenges, including game damage issues, and increases in the population beyond objective levels.

Dietary Overlap of American Barn Owl and Short-Eared Owl in the Mission Valley, Montana

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The Mission Valley is home to many species of wildlife, including the Short-eared owl. Over the last decade Barn Owl sightings have increased in the valley and nests have been discovered. We analyzed food-niche overlap between American Barn Owls (*Tyto furnata*) and Short-eared Owls (*Asio flammeus*) over one year to determine whether prey competition from the local Barn Owl population will affect the Short-eared Owl population. A total of 325 prey items (11 different species) were identified from 152 pellets; 79 Barn Owl and 73 Short-eared Owl. Diets of both species consisted primarily of *Microtus* species, although traces of additional food resources were present. Using Pianka's index the food-niche overlap was 0.658, where Pianka's index determines what proportion of the two owl species' diets overlap with a value of 0 representing total separation and a value of 1 representing total overlap. The results of this study showed a food niche overlap between the two owl species. We suggest, however, that the current population of Barn Owl in the Mission Valley is not directly competing with the established Short-eared Owl population in the Mission Valley, given the

availability of alternative food resources. The consequence of small mammal population dynamics in this study is also addressed.

Mapping the Future of Oil and Gas Development in Relation to the Conservation of Greater Sage Grouse

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Frederick, Robert B., Department of Biology, Eastern Kentucky University, Richmond, KY
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Greg Watson, Office of Landscape Conservation, USDI – Fish and Wildlife Service, Denver, CO

The effects of oil and gas development on the conservation of greater sage grouse (*Centrocercus urophasianus*) is of concern in the Northeastern portion of their current range that coincides partially with grouse Management Zones I, II, and IV. Although some research has reported on these effects, much remains uncertain. This is often the case with ecological studies where cause-effect relationships are complex, multivariate, and involve landscape perspectives. Gaining an understanding of the effects of the development on grouse requires predicting where that development is expected to occur on a landscape level. We gathered the "reasonable foreseeable development" spatial data from the USDI's Bureau of Land Management that were available for Montana, North Dakota, South Dakota, Wyoming, and Northwestern Colorado. These data were disparate across the study area, and we standardized them across mapping units to establish consistent and quantitative categories. We describe the GIS processes used to accomplish that and to display the number of wells per township as projected in the BLM data. The data were then overlain with the priority areas for conservation for greater sage grouse. Our data, metadata, and data processing (standardization) documentation will be made available on the web via the Landscape Conservation Management and Analysis Portal (LCMAP— https://www.sciencebase.gov/ catalog/?community=LC+MAP+-+Landscape+Conservation+Management+and+Analysis+Portal). Companion research to model the risk to greater sage grouse from oil and gas development has also begun. This uses artificial intelligence and Bayesian belief network software to represent knowledge and its uncertainty as presented in the scientific literature, and we present our conceptual model.

Movements and Habitat Use of Northern Saw-Whet Owls During Fall Migration

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William Blake, Biologist, MPG Ranch, Florence, MT

We used radio telemetry to track the movements and habitat use of Northern Saw-whet Owls (*Aegolius acadicus*) as they traveled south through the Bitterroot Valley during fall migration. We deployed 38 units over the course of 3 weeks in late September and early October 2014. We hypothesized that owls would use the Bitterroot River floodplain as a travel route, because this landscape feature offers continuous vegetative cover the whole length of the Bitterroot Valley. Instead, many owls traveled along the periphery of the valley, through the forested foothills of both the Bitterroot and Sapphire Mountains. In many cases, their locations suggested that they crossed over landscapes offering little vegetative cover. Our greatest nightly distance moved was 26 miles. We tracked one owl a distance of approximately 60 miles from the banding station. Many owls exhibited stopover behavior, staying in the same general area for several days between movements. Some owls did not

migrate; we do not know if these individuals were year-round residents or overwintering owls arriving from other areas. Our ability to document roost-site characteristics of both migratory and resident owls was constrained by the common use of tall ponderosa pines for roosting, limiting our ability to precisely locate owls, even with telemetry equipment. This result suggests that methods relying on passive observation to detect owls and/or roost sites likely miss the majority of roost sites, at least during migration. We documented one communal roost containing at least three individuals.

Montana Pergrine Falcon Survey: 2014

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The release of 617 captive-bred young during the 1980's and 1990's sparked the recovery of the Peregrine Falcon (*Falco peregrinus*) in Montana. By 1994, a mix of state, federal, and private biologists (Montana Peregrine Falcon Working Group) documented 13 known active Peregrine Falcon territories. For the following four years, the number of known territories averaged about 16, but then intensive survey efforts in 1999 documented a total of 28 territories. The number of active Peregrine Falcon territories discovered in Montana has increased yearly. Montana had a record number of 108 active Peregrine Falcon territories recorded during the 2012 field season. By the end of the 2014 field season, we have recorded 166 active Peregrine Falcon territories. Montana Peregrine Falcon surveys are conducted in conjunction with the USFWS national surveys scheduled every three years, beginning in 2002 and ending in 2015. Annual survey objectives include the establishment of a citizens group (Project Peregrine Watch) to monitor individual Peregrine territories throughout the state, determine status and trends of Montana's Peregrine Falcon population, study all known historic Peregrine Falcon eyries, record occupancy and productivity at all active territories, locate new Peregrine Falcon territories, seek confirm and consolidate information from all public and private sources, record activity and locations of neighboring cliff-nesting raptors Prairie Falcon (*Falco mexicanus*), Golden Eagle (*Aquila chrysaetos*), and the Red-tailed Hawk (*Buteo jamaicensis*), and develop , a long-term and cost-effective monitoring program for determining annual status and population trends of the State's Peregrine Falcon population.

MT Legislature and Wildlife 101

Robert R. Ream, former Chair of Montana Fish, Wildlife and Parks Commission
Amy Seaman, Bird Conservation Associate & Lobbyist MT Audubon Society, Helena, MT

Bob Ream and Jake Troyer will lead an educational discussion about the Montana Legislature. The discussion will center on the best ways to engage with legislators, critical wildlife legislation introduced in the 2015 Montana Legislature, and how you can get involved as a citizen advocate on the issues that are most important to you.

Investigating Habitat Characteristics Important to Hoary Marmots in Montana

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Alpine ecosystems will be impacted by climate change, which will shift distributions of alpine species on the landscape. Understanding which habitat characteristics are important to alpine species will be necessary to predict changes in distribution reliably. The hoary marmot (*Marmota caligata*) is an alpine obligate whose range extends from Alaska into western Montana. Although hoary marmots are relatively abundant, they are a potential species of concern in Montana because we lack information on their distribution and habitat requirements. We initiated a project to investigate the genetic connectivity and habitat characteristics that promote occupancy of marmots. Between June and August 2014, we visited five mountain ranges in search of hoary marmots. At two to three sites per mountain range, we trapped marmots for genetic samples and surveyed areas visually to quantify occupancy. We sampled 47 sites during 79 surveys; at least one marmot was detected by at least one observer in 12 of these surveys (15%). Marmots were more likely to occupy sites with increased cover of boulders and wet meadow and less likely to occupy sites with increased cover of shrubs and grasses. Overall, the probability of detecting a marmot was 0.59 (SE = 0.10) and the probability of occupancy across all sites was 0.27 (SE = 0.10). Our work will provide information about non-game species in alpine environments and inform the design of monitoring programs that can aid managers as they begin to understand where hoary marmots are on the landscape and where they could be in the future.

Bat Use of Bridges in Missoula, Ravalli, and Mineral Counties in Western Montana (Oral Presentation and Poster)

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Many North American bat species are declining as populations face increasing pressure from disease and degradation or loss of habitat. Bats roost in natural and artificial structures with adequate crevices. It is important to document the structural and thermal characteristics of these roosts across the landscape in order to provide natural resource managers with tools to protect and conserve these species. Bat use of bridges has been well documented in the southwest United States, but bridges in northwest Montana were not surveyed because temperatures were thought to be insufficient for bats. This lack of knowledge was the basis for our survey of roadway bridges in Missoula, Ravalli, and Mineral Counties. In May-October 2014 we visited 412 bridges and categorized them as day roost, night roost, maternity colony, or no detectable use. We detected widespread use of bridges (45.9%) as night roosts used between foraging flights. Bats were detected in day roosts at a smaller number of bridges (2.7%) with use ranging from solitary bats to hundreds of females and offspring. Bridge type and structure appear to be significant in predicting bat use, and initial temperature data indicate that day roosts have a slightly higher temperature regime than unoccupied bridges. Survey and bat detection information is available to resource managers via the Montana Natural Heritage Program's MapViewer web application (http://mtnhp.org/mapviewer). In consideration of the potential importance of these artificial roosts to bat species, we encourage the evaluation of roadway bridges for bat use prior to maintenance or replacement activities.

Thirty Years Of Wetland Conservation In Montana

Catherine S. Wightman*, Montana Fish, Wildlife and Parks, Helena, MT
James L. Hansen, Montana Fish, Wildlife and Parks, Billings, MT
Mark G. Sullivan, Montana Fish, Wildlife and Parks, Glasgow, MT
Rick D. Northrup, Montana Fish, Wildlife and Parks, Helena, MT

In 1985 the Montana Legislature authorized the Department of Fish, Wildlife and Parks (FWP) to use funds from migratory bird hunting licenses "…for the protection, conservation, and development of wetlands in Montana", thereby creating the Migratory Bird Wetland Program (a.k.a. State Duck Stamp Program). Wetlands and their associated uplands provide critical nesting, foraging, brood-rearing, and migration habitat for waterfowl and other wetland-associated wildlife. Wetlands also provide critical ecosystem functions important for our communities and wildlife, including water purification, flood control, and groundwater recharge. FWP's Migratory Bird Wetland Program is dedicated to conserving wetlands and associated uplands to benefit Montana's wildlife, especially migratory birds, to enhance consumptive and non-consumptive recreational opportunities, and to maintain wetland systems for Montana's citizens. Since many of the opportunities were on private land, it was essential for FWP personnel to learn how best to work with farmers and ranchers to benefit their operations as well as wildlife and wetland values. In addition to the partnership of private landowners, many other agencies and organizations have been partners in habitat projects. The program has adapted to changing opportunities and conservation needs over time. We will chronicle the past 30 years of program implementation, showcase successes, and discuss a philosophy for continued wetland conservation into the future.

Is Science Meeting the Needs of Land Management? A Case Study of the USFS and the Fisher

Dave Wrobleski, Wildlife Biologist, USFS, Lolo National Forest

Laws including the National Environmental Policy Act, National Forest Management Act and Endangered Species Act require both knowledge of potential effects on wildlife species and specify what effects may or may not occur to species. In the context of land management agencies such as the U.S. Forest Service, before a timber harvest, prescribed fire, or wildlife habitat improvement project occurs, these laws require a wildlife biologist to disclose the effects of the project on wildlife species and propose options to reduce potential negative effects. Decision-makers are then required to consider these effects and prevent jeopardizing listed species or impacting viability of "sensitive" species. These legal requirements result in biologists producing a report called a Biological Evaluation and Assessment specifying how a project would affect sensitive and federally listed species. Wildlife research is used to answer the following questions about each species of interest including, status, trend, habitat, applicable survey data, and mechanisms of effects on species. The key piece of information needed is the effect on the individual and population as a whole. However, the less research is available, the more logic and reasoned speculation are used to estimate these potential effects. Discerning the effect on the individual and population as a whole is usually based on little science because the science rarely reaches this point. Thus, the most critical pieces of the analysis – *what are the effects? And how important are they?* are based upon a logic string, and of course subject to judicial review. The fisher (*Pekania pennanti*) was used as an example by comparing recent research with conclusions reached in land management

documentation. As land managers we recommend that research 1) work closely with management to insure research is as applicable as possible, and 2) that research focus on how changes in a home range may affect the individual and population and to what degree.

Poster Abstracts

Alphabetical By First Authors Last Name
***Denotes Presenter**
****Denotes Student Presenter**

Assessing the Effect of Social Information on Cerulean Warbler Settlement in South-Central Indiana (Poster)

Kevin W. Barnes*, U.S. Fish and Wildlife Service, Region 6 Division of Migratory Birds, Great Falls, MT
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Breeding bird settlement cues are typically defined by correlating occupancy to habitat related variables; however, social cues can influence breeding bird distributions and confound habitat modeling studies. The cerulean warbler (*Setophaga cerulea*) is one of the fastest declining songbirds in North America and conservation efforts would improve through a holistic understanding of breeding site selection. I assessed the influence of three forms of social information on male cerulean warbler breeding site selection: 1) pre-breeding cues, 2) post-breeding cues, and 3) clustered locational cues. The experiment was conducted by broadcasting conspecific vocalizations within plots that contain mature deciduous forests and have not contained a breeding territory over the past six years. Song was broadcasted in 2013 from the settlement to the post-fledging period. Song was broadcasted during the settlement period in another location in 2014 using a clustered speaker arrangement to mimic a breeding aggregation. Point counts were conducted every 3-6 days within treatment and control plots (no vocalizations broadcasted). Three males were detected in treatment plots during this study; however, no territories were established in treatment or control plots. Territories were not established in response to pre-breeding locational cues, post-breeding locational cues, or clustered locational cues, despite visitation by a male during these periods. These results suggest that conspecific social information does not have a strong influence on male cerulean warbler settlement. However, this experiment would be more conclusive if conducted in a part of its range where abundance is greater.

Montana's Bat Acoustic Surveillance Efforts: Pre-White-Nose Syndrome (Oral Presentation and Poster)

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Montana's bat species face a wide array of conservation issues that threaten the long-term viability of these populations. The potential arrival of White-Nose Syndrome (WNS) may be

the single greatest threat as mortality has exceeded 95% for some bat populations in eastern North America. A collaborative effort was initiated in 2011 to document year-round spatial and temporal activity patterns of Montana's bats prior to WNS arrival. In the last 4 years, we have deployed a network of over 60 Song Meter ultrasonic acoustic detector/recorder stations programmed to record bat passes from sunset to sunrise year-round. Through late December of 2014, these recording stations have resulted in more than 3.9 million full spectrum sound files containing more than 12.5 terabytes of information. Processing and automated analyses have been completed for all sound files and over 30,000 bat passes have been reviewed by hand using an updated Montana bat call characteristics key to definitively confirm the presence of species during each month of the year, identify the lowest temperatures at which individual bat species are active, and track overall bat activity, regardless of species, at each station. Highlights to-date include: 1421 new records of monthly species presence throughout the state, numerous first records of species' activity during the fall, winter, and spring months, numerous first records of species in regions with previously limited bat survey effort, documentation of nightly activity patterns throughout the year and regular winter activity for a few resident species, and the year-round presence of species previously considered migratory.

Blood-Lead Levels of Wintering Golden and Bald Eagles of the Bitterroot Valley Montana (Poster)

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Adam Shreading, Raptor View Research Institute, Missoula, MT

Lead has long been documented as a serious environmental hazard to eagles and other predatory, opportunistic and scavenging avian species. The use of lead shotgun pellets for waterfowl hunting on federal and state lands was banned in 1991 due to lead poisoning in Bald Eagles (*Haliaeetus leucocephalus*), Golden Eagles (*Aquila chrysaetos*) and numerous waterfowl species. At that time, this was thought to be the major source of the lead exposure. More recently, lead poisoning from ingested lead-bullet fragments and shotgun pellets has been identified as the leading cause of death in California Condors (*Gymnogyps californianus*), leading to a ban of lead ammunition within the "California Condor Recovery Zone." Another on-going study on Common Ravens (*Corvus corax*) and Bald Eagles in Wyoming has shown a direct correlation between very high blood-lead levels and the on-set of rifle hunting season. Indeed, there is overwhelming evidence showing that lead toxicity is still prevalent in the environment and mounting data points to fragmented rifle bullets as the source. We sampled blood from 32 Golden Eagles and 11 Bald Eagles captured on wintering grounds in the Bitterroot Valley from 2011 - Present. Eighty-six percent of eagles tested showed blood-lead concentrations higher than natural background levels. These preliminary results suggest exposure to lead is prevalent among eagles from northern latitudes wintering in the Bitterroot Valley.

Wing-Tagged Encounters of Goldens Eagles Captured in Montana (Poster)

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Recently, there has been an increase in concern for Golden Eagle (*Aquila chrysaetos*) populations in the western United States. The concern stems from a marked decrease in the number of migrants and concern over an increase in future threats from a variety of anthropogenic factors including, but not limited to, energy development. Thus, there is a need

for more information on Golden Eagles including: where they winter, longevity, causes of mortality and critical habit needs. Standard banding offers low encounter rates (<7%) and satellite telemetry is cost prohibitive. We began auxiliary marking Golden Eagles with vinyl wing-tag markers as a cost effective means to gather information on the species. Since 2004, we have wing-tagged over 214 eagles, and re-encountered 46 individuals, giving us a 21% encounter rate. This technique is proving considerably more effective than banding alone as a means of identifying individuals and receiving re-encounter information. We attribute this success, in part to internet information sharing and the increasing use of remote cameras set up on carcasses to view scavenger activity.

Bighorn Sheep Movements and Mineral Lick Use in Waterton-Glacier International Peace Park (Poster)

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This study used bighorn sheep telemetry data collected in Glacier National Park, Waterton Lakes National Park, and the Blackfeet Reservation to examine bighorn sheep movements and use of known mineral licks. Over 168,400 GPS locations were collected between 2002 and 2011 on 97 bighorn sheep individuals from 17 different social groups. We examined the proximity of bighorn sheep telemetry data to 32 known mineral lick locations to describe timing and frequency of mineral lick use. Fifty individuals had locations near known mineral licks, and most mineral lick visits took place between May and August. We compared movements towards known mineral lick locations with general bighorn sheep movements. After estimating bighorn sheep kernel home ranges, we evaluated how movement towards the lick, timing, and frequency of use varied depending on location of the lick relative to sheep home ranges. We conducted a k-means cluster analysis of movement characteristics to identify potential locations of unknown mineral licks and movement pinch points. We will discuss options for using these locations to monitor bighorn sheep health and population size.

Spatiotemporal Variability in Biomass and Forage Quality Across a Temperate Landscape with Heterogeneous Phenology Patterns (Poster)

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Although spatial and temporal heterogeneity in grassland biomass and forage quality is well-recognized to play an important role in migratory ungulate population dynamics, attempts to directly quantify biomass and forage quality across temperate landscapes throughout the growing season are limited. It is generally recognized that biomass and forage quality are directly related to phenology, but little is known about how seasonal biomass and forage quality differs across land use and biophysical gradients with varying phenology patterns. This study uses field estimates of biomass, chlorophyll concentration, crude protein, and in vitro dry matter digestibility collected from 20, 250m^2 grassland plots throughout the

summers of 2013 and 2014 to quantify how biomass and forage quality differ across land uses and biophysical gradients in the migratory elk (*Cervus elaphus*) range in the Upper Yellowstone River Basin. Key findings were that irrigated agriculture had overall greater and longer available biomass and forage quality throughout the growing season compared to private and public grasslands with natural phenology patterns. And that areas that begin growth later in the season had overall greater biomass and forage quality than areas with mid and early phenology characteristics, but availability was shorter. These results suggest that seasonal patterns of biomass and forage quality differ with phenological characteristics across temperate landscapes. This information should be incorporated in our understanding of spatiotemporal patterns of vegetation important for studying migratory ungulate ecology and predicting the effects of climate change and human land use on vegetation dynamics in temperate landscapes.

Through Citizen Science (Poster)

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Jami Belt, Glacier National Park, West Glacier, MT
Kristina Boyd, Yaak Valley Forest Council, Troy MT

The spatial and temporal availability of grizzly bear foods influences bear health and reproduction and is likely to change with the changing climate. Even short-term shortages of bear foods may increase bear movements into human settlements and the potential for conflicts, which may lead to increased bear mortality. However, climate drivers of bear food availability are poorly understood and few resources are available for long-term monitoring at a spatial scale to adequately connect food availability to climate. We are proposing to evaluate citizen science as a potential mechanism for researching and monitoring relationships of multiple bear food sources with climate change. We have several questions and are seeking input: 1) How much interest is there among various groups (e.g., Glacier National Park visitors, Salish tribal members, Blackfeet tribal members, backcountry horsemen, naturalists, conservation group members) in collecting these kinds of data? 2) What are the best protocols for citizen scientists to measure bear food availability across the ecosystem? 3) What would the ongoing costs be for coordinating a citizen science program? We will discuss several ideas for which we are seeking pilot project funding that will help to answer these questions, including 1) a geocaching app that would initially target park visitors and school programs to collect huckleberry phenology and berry abundance data, and 2) multiple ways to engage citizens in using National Phenology Network protocols.

A GIS Tool for Applying Habitat Suitability Models to Inform Management (Poster)

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Habitat suitability models are used to guide habitat management for species of conservation concern. Models quantify relationships between known species locations and environmental attributes, which are used to identify and map areas most likely to support species of concern. Managers can then restrict human activities with negative impacts on habitat suitability in these areas. Application of habitat suitability models, however, typically requires technical expertise not available to most land managers. We developed a prototype

GIS tool that facilitates application of habitat suitability models to guide management of habitat for woodpecker species of conservation concern. The tool operates within an ArcGIS environment, which is readily available to most managers, and will be capable of generating habitat suitability maps for several species of concern (i.e., Black-backed Woodpecker [*Picoides arcticus*], Three-toed Woodpecker [*P. dorsalis*], Lewis's Woodpecker [*Melanerpes lewis*], and White-headed Woodpeckers [*P. albolvartus*]). The tool also automates much of the model application process, reducing requisite technical expertise, and making habitat suitability models widely available. The tool will be accompanied by a manual describing implementation and interpretation of resulting habitat suitability maps. The tool will be especially helpful for informing management of post-disturbance forests (i.e. after wildfire and beetle infestations) to identify suitable habitat for disturbance specialists (e.g., Black-backed, Three-toed, and Lewis's Woodpeckers). Identification of suitable habitat is necessary to effectively develop management plans that incorporate the needs of habitat specialists in post-disturbance landscapes. Our prototype is currently being tested by U.S. Forest Service biologists.

Acoustic Monitoring of Nocturnal Migrants in the Bitterroot Valley, Montana (Poster)

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Many avian species migrate under the cover of darkness, limiting our ability to study migration phenomena. Some migrants emit nocturnal flight calls (NFCs) to presumably echolocate and maintain communication with other birds. NFC monitoring provides a reliable, passive, and unbiased way to document species composition and spatial and temporal components of nocturnal migration. During spring and fall migration of 2013 and 2014, we installed autonomous recording units (ARUs) at low-, mid-, and high-elevation sites. ARUs record NFCs and allow spectrogram generation, followed by species-level identification. From the recordings, we extracted and analyzed over 6000 NFCs from sparrows, warblers, and thrush-like species. Our data show that we can track annual, seasonal, weekly, and nightly trends as well as patterns between monitoring sites. We found more NFCs in 2014 compared to 2013, substantially more NFCs in fall than in spring, and saw differences in nightly detections times between different bird groups. Across the three monitoring sites, the mid-elevation site continued to record the most NFCs during fall migration. In 2015, we plan to finish the species-level classification and compare the results to other survey methods (e.g., bird banding and visual surveys). We also plan to monitor NFCs for a third year to confirm these patterns persist. An additional year of monitoring will provide a good baseline to monitor future population trends and migration pathways.

2014 Statewide Winter Owl Surveys (Oral Presentation and Poster)

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Lauri Hanauska-Brown, Montana Fish, Wildlife, and Parks, Helena, MT

Localized winter owl surveys have been conducted in Montana in the past, but a coordinated statewide effort had never been undertaken. Eleven owl species were, therefore, listed as Species of Highest Inventory Need by Montana Fish, Wildlife, and Parks and the Montana Natural Heritage Program. We coordinated statewide winter owl call surveys in 180 of the 185 quarter latitude/longitude (QLL) blocks that encompass Montana. Call transects each consisted of 10 call stations spaced at 1-mile intervals along a 9-mile long road transect

within a QLL block. At each call station, observers alternately silently listened for owl calls and played owl calls for species likely to occur in the surrounding habitat. A total of 1,829 call stations were surveyed and a total of 511 owls across 11 owl species were detected. Detections during the 2014 surveys nearly, or more than, doubled the number of records with indirect evidence for breeding that have been gathered in Montana across all time for Eastern Screech-Owl, Great Horned Owl, Long-eared Owl, and Short-eared Owl. We recommend that these species and the Northern Saw-whet Owl be removed from the Montana Species of Highest Inventory Need as a result of the information gathered during these surveys.

Montana's Winter Bat Roost and White-Nose Syndrome Surveillance Efforts (Oral Presentation and Poster)

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Lauri Hanauska-Brown, Montana Fish, Wildlife, and Parks, Helena, MT
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Chris Servheen, U.S. Fish and Wildlife Service, Missoula, MT
Bigfork High School Cave Club, http://bigforkhighschoolcaveclub.weebly.com
Northern Rocky Mountain Grotto, http://nrmg.cavesofmontana.org

White-Nose Syndrome (WNS), caused by the cold-adapted soil fungus *Pseudogymnoascus destructans*, has killed an estimated 5.7 to 6.7 million bats in eastern North America since 2006 and has spread westward to states along the Mississippi River corridor as well as the province of Ontario. With at least 9 of Montana's 15 known bat species facing potentially devastating increases in mortality from WNS, a collaborative effort was initiated in the fall of 2011 to document the species composition, number, degree of clustering, and roost temperatures and humidities of bats winter roosting in caves and mines. To-date, collaborators have surveyed over 50 caves and mines, deploying over 30 temperature and relative humidity data loggers near winter roosting bats; most known bat hibernacula in Montana are now being monitored. Most caves and mines surveyed to date support only small numbers of winter roosting bats; typically less than ten roosting in isolation or clusters of two to three. A handful of caves have 50-1750 winter roosting bats with clusters of up to 40 individuals. Many of the caves that have been surveyed have temperatures and humidities that appear to be capable of supporting *P. destructans*, but PCR-based testing of bat and substrate swabs have tested negative for its presence so far. The majority of Montana bats apparently winter roost away from mines or caves that are accessible to, or known by, humans and these roosts need to be located and assessed for their ability to support *P. destructans*.

Monitoring Huckleberries for Invasive Fruit Flies and Climate Change Impacts on the Flathead Indian Reservation (Poster)

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Tabitha A Graves, USGS Northern Rocky Mountain Science Center, West Glacier, MT
Janene Lichtenberg, Natural Resources, Salish Kootenai College, Pablo, MT

The huckleberry (*Vaccinium spp.*) has been important to both bears and the Salish people for hundreds of years. With predicted climate changes including increasing temperature, increasing variability in weather, and unknown changes in precipitation it is important to understand effects on huckleberry plants on the Flathead Reservation. In this project, we

are proposing to extend huckleberry phenology research in Glacier National Park led by Dr. Tabitha Graves to the Flathead Reservation. The USGS project aims to understand potential climate change impacts on grizzly bear food sources, a research need identified in a workshop evaluating climate change impacts to grizzly bears (Servheen and Cross 2010). Two potential impacts include 1) changes in phenology that could impact pollination rates and thus productivity and 2) the possible presence of an invasive fruit fly, the spotted wing drosophila that lays eggs in ripe fruit, and can cause the fruit to drop off early. I will use remote cameras that record pictures every day to measure the length of time individual flowers bloom and individual berries are present. This will be used to evaluate how flowering time and duration and ripe berry time and duration varies with temperature across sites that range in precipitation and solar radiation. Productivity metrics will be recorded at the peak of the berry season. All findings and conclusions will be a part of my senior thesis and will be provided to the Confederated Salish and Kootenai Tribes.

Bat Use of Bridges in Missoula, Ravalli, and Mineral Counties in Western Montana (Oral Presentation and Poster)

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Many North American bat species are declining as populations face increasing pressure from disease and degradation or loss of habitat. Bats roost in natural and artificial structures with adequate crevices. It is important to document the structural and thermal characteristics of these roosts across the landscape in order to provide natural resource managers with tools to protect and conserve these species. Bat use of bridges has been well documented in the southwest United States, but bridges in northwest Montana were not surveyed because temperatures were thought to be insufficient for bats. This lack of knowledge was the basis for our survey of roadway bridges in Missoula, Ravalli, and Mineral Counties. In May-October 2014 we visited 412 bridges and categorized them as day roost, night roost, maternity colony, or no detectable use. We detected widespread use of bridges (45.9%) as night roosts used between foraging flights. Bats were detected in day roosts at a smaller number of bridges (2.7%) with use ranging from solitary bats to hundreds of females and offspring. Bridge type and structure appear to be significant in predicting bat use, and initial temperature data indicate that day roosts have a slightly higher temperature regime than unoccupied bridges. Survey and bat detection information is available to resource managers via the Montana Natural Heritage Program's MapViewer web application (http://mtnhp.org/mapviewer). In consideration of the potential importance of these artificial roosts to bat species, we encourage the evaluation of roadway bridges for bat use prior to maintenance or replacement activities.